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THESIS

AN ANALYSIS OF THE RELATIONSHIP BETWEEN MARITAL STATUS AND FAMILY STRUCTURE AND ON-THE-JOB PRODUCTIVITY

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13. ABSTRACT ***(maximum 200 words)***

That married male workers earn more than their unmarried co-workers is now well established in the labor economics literature. Traditional estimates of this marriage premium range from 10 to 40 percent. However, the source of this wage difference between married and unmarried men remains obscure. Some economists attribute this wage differential to differences in job productivity between married and single workers. Other economists attribute the wage differential to unobserved characteristics of married workers, i.e., selection effects. This thesis seeks to examine the possible causes of differences in job performance between married and single employers using data on Navy officers. The analysis shows that married male officers receive higher supervisor evaluation scores and promote at higher rates than single male officers. The results also show that there is a positive correlation between supervisor evaluations and promotion. The analysis of the effects of marital status shows that married officers achieved better performance than single officers. Unrestricted line (URL) male officers who have been married longer receive higher performance scores. For both URL and Staff / Restricted Line (STF/RL) male officers performance also increase as the number of dependents increase. OLS regression models also show that male officers who are married have attained more graduate education than single officers. The analysis of selection bias shows that single male officers who will marry in the future perform better than single officers who will remain single in the future. Fixed-effects models that control unobservable individual characteristics support the higher performance of married males. Finally, Heckman style two-step models that control for selection bias due to retention decisions show that the measured effect of marriage is biased upward in single stage models, but that the bias is not large.

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AN ANALYSIS OF THE RELATIONSHIP BETWEEN MARITAL STATUS AND FAMILY STRUCTURE AND ON-THE-JOB PRODUCTIVITY

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ABSTRACT

That married male workers earn more than their unmarried co-workers is now well established in the labor economics literature. Traditional estimates of this marriage premium range from 10 to 40 percent. However, the source of this wage difference between married and unmarried men remains obscure. Some economists attribute this wage differential to differences in job productivity between married and single workers. Other economists attribute the wage differential to unobserved characteristics of married workers, i.e., selection effects. This thesis seeks to examine the possible causes of differences in job performance between married and single employers using data on Navy officers.

The analysis shows that married male officers receive higher supervisor evaluation scores and promote at higher rates than single male officers. The results also show that there is a positive correlation between supervisor evaluations and promotion.

The analysis of the effects of marital status shows that married officers achieved better performance than single officers. Unrestricted line (URL) male officers who have been married longer receive higher performance scores. For both URL and Staff / Restricted Line (STF/RL) male officers performance also increase as the number of dependents increase. OLS regression models also show that male officers who are married have attained more graduate education than single officers.

The analysis of selection bias shows that single male officers who will marry in the future perform better than single officers who will remain single in the future. Fixed-effects models that control unobservable individual characteristics support the higher performance of married males. Finally, Heckman style two-step models that control for selection bias due to retention decisions show that the measured effect of marriage is biased upward in single stage models, but that the bias is not large.

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I. INTRODUCTION

A. PROBLEM DESCRIPTION

It is a fairly well established fact that married male workers earn more than single male co-workers in the civilian sector. Traditional estimates of this marriage premium range from 10 to 40 percent. However, the source of this wage difference between married men and single men remains debatable. Some economists attribute this wage differential to the increased productivity of married workers created by specialization between husbands and wives. Others attribute this wage differential to the selective characteristics of married workers. As regards the military sector, only one study (Anderson and Krieg, 2000) has previously examined the effects of marital status and family size on job performance.

This thesis will utilize data on U.S. Navy officers to analyze the effect of marital status on job performance. The thesis seeks to determine whether a marriage premium exists among U.S. Navy officers with respect to their marital status and family size, the degree to which the magnitude of the marriage premium differs between single and married officers and among officers with different numbers of dependents, and, more importantly, the reasons for the differentials.

B. THESIS PURPOSE

The purpose of this research is first to find if marriage and family size affect the productivity of U.S. Navy officers. The second goal is to obtain an unbiased estimate of the effects of marriage on officer productivity by controlling for selectivity associated with the characteristics of officers who marry versus those who are single.

C. THESIS SCOPE

The scope of this research has six parts: (1) reviewing previous studies; (2) analyzing basic characteristics of data; (3) addressing main issues with methodologies; (4) estimating models and testing hypotheses; (5) summarizing major findings and recommendations; and (6) discussing limitations of the study and possible extensions.

D. RESEARCH QUESTIONS

The primary research questions addressed by this thesis are:

1. Does marital status and number of dependents affect the productivity of civilian workers?
2. Do married and single officers in the U.S. Navy have significantly different demographic characteristics?
3. What indicators are available to analyze the productivity of U.S. Navy officers?
4. Does marital status and number of dependents affect the productivity of U.S. Navy officers?
5. For U.S. Navy officers, how does the effect of marriage on productivity differ in accordance with the accumulated years of marriage and the number of dependents?
6. Can selection bias be eliminated in explaining the marriage premium for the U.S. Navy officer population?

E. THESIS ORGANIZATION

This thesis consists of the following chapters:

Chapter I: INTRODUCTION. Introduces the problem, purpose, and scope of thesis and presents the research questions and the organization of this thesis.

Chapter II: BACKGROUND. Summarizes the major hypotheses about the cause of marriage premium and findings on the existence and size of the premiums.

Chapter III: LITERATURE REVIEW. Discusses the mostly civilian studies on the marriage premium, the data sets used, model specifications and the major findings.

Chapter IV: DATA. Describes the personnel system of U.S. Navy officers (officer promotion, up-or-out policy, and promotion tournament system), officers' family life, the basic characteristics of the data, and proxies available to measure officer's on-the-job productivity.

Chapter V: METHODOLOGY. Discusses methodologies to estimate the multivariate models.

Chapter V: MODEL SPECIFICATION AND RESULTS. Describes the main specification issues and development of each model and interprets the results of models.

Chapter VI: CONCLUSIONS AND RECOMMENDATIONS. Summarizes the major findings from the study, recognizes limitations of the thesis, and provides recommendations for further research.

II. BACKGROUND

A. INTRODUCTION

Labor economists have conducted numerous studies to analyze the determinants of productivity. Since it is difficult to find direct data on the productivity of an employee, economists have used proxies to measure an employee's on-the-job productivity. Under the assumption that the labor market is competitive, firms will base the pay of workers on the value of their marginal productivity (Ehrenberg and Smith, 2000). Thus, wages and earnings can be used as proxies for productivity. In addition, data on wages is more readily available than data on actual worker productivity. When available, performance ratings and promotion variables have been used as indicators of productivity. In previous studies using wages and earnings as proxies for productivity, economists analyzed the effects of formal education, firm specific training, marital status, age, ethnic background, gender, and other demographic characteristics.

That civilian married male workers earn more than their unmarried co-workers is now well established in the literature. Traditional estimates of this marriage premium range from 10 to 40 percent. However, the source of this wage difference between married men and unmarried men remains debatable. Some economists attribute this wage differential to the differences in job productivity of married workers and single workers. Other economists attribute the wage differential to unobserved characteristics of married workers, i.e., selection effects.

B. ALTERNATIVE EXPLANATIONS OF THE MARRIAGE PREMIUM

Several studies have analyzed the effects of marital status of civilian workers on their productivity, or more precisely, on their wages. Most of these studies have found that the wages of married males are significantly higher than otherwise equivalent single workers.

The studies differ from each other in their explanations of the probable reasons for the higher wages of married males. There are two major explanations for the marriage premium. One is that the higher earnings of married men are associated with higher productivity, which is associated with being married. This hypothesis claims that

marriage directly increases the worker's productivity on the job. The second major hypothesis contradicts the positive association between marital status and on-the-job productivity. Researchers supporting the second hypothesis attribute the higher marital wage/earnings differentials to selection bias, employer favoritism of married workers, or other explanations.

1. Marriage Makes Men More Productive

One of the first studies to claim that marriage increases the productivity of married men was by Hill (1979). She shows that married male workers earned 25-50 percent higher wages than single male workers. When she added numerous controls for worker qualifications in her regression model, the positive earnings differential remained. Based on this finding, she claims the higher earnings of married men are not caused by unobservable individual characteristics, but rather are the result of increased productivity due to marriage.

Korenman and Neumark (1991) conclude that marriage increases on-the–job productivity of men working in the labor market based on two important findings in their study. First, they found that wages were significantly higher for married men even:

> after controlling for selectivity into marriage based on fixed unobservables. Over eighty percent of the estimated impact of marriage on earnings survived the fixed-effects estimation. Moreover, large marriage premiums persisted even after adding controls to wage equations that should capture differences across marital status in the labor supply or in the investment in human capital. (p. 296)

Their second finding was that the marriage premium continues to increase with each additional year of marriage. They claim that if the marriage premium resulted from the selection of men with unobservable individual characteristics, then we would not expect the marriage wage premium to rise based on the number of years married.

Chun and Lee (2001) find that married men earn 12.4 percent more than men who never married after controlling for education, work experience, ethnic background, and factors that may affect both wages and marriage prospects. They also find that after controlling for selection, the unobservable attributes that might be associated with earning capabilities, married men still earn higher wages than men who never married. They claim that unmeasured earning capabilities are not correlated with unobservable

characteristics of individuals that are valued in the marriage process. They attribute the marriage premium to a worker's increased productivity.

However, the question remains as to what factors cause the increased productivity of married men. Economists usually cite the following reasons for why marriage increases the productivity of married male workers.

a. Married Workers Are Able to Specialize in Labor Market Activities

One argument is that the marital wage premium is caused by household specialization. Becker (1973, 1981) showed that marriage is economically beneficial because it makes greater specialization possible. He suggests that married workers are able to specialize in labor market activities while their spouses specialize in household production. Marriage causes the high wage-earning spouse, usually the male, to spend more time working in the market, and the low wage-earning spouse, usually the wife, to spend more time in household work. Women experience lower labor force participation rates due to the responsibility of bearing and raising children. Women consequently have less incentive to devote as much time and energy to work as men.

Chun and Lee (2001) report that the marriage differential between married and never-married men decreases as wives put in more work hours outside the home. While married men whose wives are not working in the labor market earn 31.4 percent more per hour than men who never married, men whose wives are working 40 hours a week in the labor market earn only 3.4 percent more. Based on these findings, they claim that the marriage premium is explained by specialization within the household.

On the other hand, two studies present evidence against the argument that marriage enables married men to specialize in market work. Jacobsen and Rayack (1996) estimate the effects of the wife's labor market hours on the husband's earnings with three different models. OLS estimates show that men whose wives do not work in the labor market earn 15 percent more than those whose wives work in the labor market. However, they do not rely on the OLS estimates since this model ignores the endogeneity problem. They estimate the effects of the wife's labor market hours with both 'two-stage' and 'fixed effects' models. The results from these two models reveal no significant difference in earnings between husbands whose wives work in the labor market and those whose

wives do not. Based on these findings, they conclude that the reason for the marriage premium is not the greater productivity of men due to household specialization.

Hersch and Stratton (2000) also agree that the household specialization argument does not appear to explain the marriage premium. They claim that using the wives' market hours is not a good indicator to measure household specialization. They claim that working wives in the labor market may affect the time the husband spends on household work in the opposite direction.

> Married men with employed wives may spend less time on housework than men whose wives are not employed because household income is greater, or they may spend more time because the value of their spouse's time may be greater. The net effect will depend on the magnitude of these two components. (p. 80)

Due to the weakness of using wives' market hours to test the household specialization, they calculate the hours spent on housework by both married and single men. They find that married men spent the same amount of time on home production as single men. They conclude that the marriage premium does not seem to have resulted from greater household specialization.

b. Married Men Make More Investments in Human Capital

A second reason that has been advanced for the marriage wage differential is the greater investments in human capital made by married males. The additional investment in human capital is the reason for the higher wages or productivity. Kenny (1983), citing Becker (1973, 1981), suggests two explanations why married men accumulate human capital more rapidly when they are married than when they are not married. A married man can finance his training by borrowing from his wife's earnings at rates lower than those available in outside capital markets. The other suggestion is that since married men anticipate spending a large fraction of their lifetime working because of family responsibilities, they are willing to invest more in human capital to reap the benefits for a longer period of time in the future. In this situation, the marginal cost of training is lower for married men.

On the other hand, Cornwell and Rupert (1997), citing Bergstrom and Schoeni (1992), do not accept the argument that marriage makes it cheaper to accumulate

human capital. They base this conclusion on the finding that "individuals who acquire more formal education tend to marry later than those who acquire less." (p. 285)

2. Marriage Does Not Increase Productivity

Loh (1996) claims that the conclusions of the previous studies explaining why married men earn more than unmarried men are not persuasive. In his study, Loh was able to contradict the two explanations for why marriage makes men more productive: (1) married men make greater investments in human capital; and (2) married men specialize in market work while the wife specializes in housework. First, he demonstrates that there is no difference in the marriage premium between two husbands depending on whether they have a working or non-working wife. This once again contradicts the hypothesis that married men with non-working wives have a greater opportunity to accumulate human capital. The second finding showed that the time spent by the man with his wife before marriage does not affect the marriage premium, which also contradicts the hypothesis that non-working wives specialize in household work while husbands specialize in market work.

Cornwell and Rupert (1996), using the same data set used by Korenman and Neumark (1991), reach conclusions just the opposite of those of Korenman and Neumark (KN). Cornwell and Rupert (CR) find that the time spent in marriage has no significant effect on wages. CR suggest that this finding stands as evidence against the argument that marriage increases productivity. CR attribute the reasons why they find opposite results from KN (KN find the marriage premium and the time spent in marriage are positively correlated) to using a longer period when analyzing the marriage premium by calculating the "variation over time in the regressors." CR track individuals for ten years from age 19 to age 29, whereas KN track the same individuals from age 24 to 29.

a. Marriage Premium is Due to Selection Bias

The selection hypothesis argues that married workers receive more pay because they have different unobservable characteristics that are correlated both with their productivity and their marital status. Their higher wages are due to these characteristics, and even if they were not married, they would earn more than single workers.

Nakosteen and Zimmer (1987) stress the importance of the potential correlation between the factors that influence both marital status and earnings but that remain unobserved by the researcher in causing biased estimates of the marital status variable. They try to eliminate the possibility that a process whose random unobservable component is correlated with unobservables in the wage function determines the marital status stochastically. They build a model in which "the individual's marital status and subsequent earnings are determined in a manner that permits endogeneity among outcomes." (p. 250) They conclude that when the model is estimated in a manner that addresses the potential for endogenous selection, marital status fails to emerge as a source of enhanced earnings.

Cornwell and Rupert (1996) show that single men who will marry in the future earn more than single men who will not marry in the future. The first group earns at least as much as those who are already married. They claim that this finding shows that married men have characteristics valued in both the marriage and labor markets such as ability, honesty, loyalty, dependability and determination.

Ginther and Zavodny (1998) test the argument that the apparent marriage premium is due to selection bias by measuring the effect of 'shotgun' weddings on marriage. They claim that by using this "natural experiment" they can estimate the effects of marital status in a way that is not correlated with the earning ability for some men. Their assumptions are that the likelihood of a premarital conception and likelihood that the couple marries is random. These outcomes may not be correlated with unobservable, potentially more 'qualified' characteristics of men who will marry. They estimate cross-sectional and fixed effects regressions for the two types of married men. The apparent marriage premium calculated from cross-section regressions disappears when the marriage premium is calculated in fixed effects regressions for both types of married men. Thus, they show that the marriage premium is due to selection bias.

The fixed-effect and cross-sectional regressions show a lower marriage premium for married men with a premarital conception. This means that a higher marriage premium for married men without a premarital conception is due to selection into marriage because of their higher wage earning characteristics. If the marriage

premium were due to increased productivity, this difference in productivity would have been seen in both types of marriages.

b. Employers Pay More to Married Men because of a Signaling Mechanism

Another hypothesis is that the wage difference between married and unmarried men is due to employers' preferences for married workers over single workers due to employers' perceptions that married workers are more responsible or stable. Perhaps marriage signals the ability to assume greater responsibilities. Thus, married workers are paid more. Another potential explanation for why supervisors favor married workers is that supervisors are usually older and more likely to be married. If so, married supervisors may understand the increased responsibilities of their married subordinates and support them with better pay.

Hill (1979) suggests that the higher earnings of married men may be a result of employer discrimination in favor of married workers. She says the marriage premium may arise because "employers' wage decisions are in part based on paternalistic attitudes which lead them to feel that workers with greater financial responsibilities to their families deserve higher wages." (p. 592) She also suggests that workers with greater financial responsibilities may also be more adamant in pushing employers for higher wages.

Loh (1996) tried to determine whether the marriage premium is caused by employer favoritism. He claims that if there is no effect of employer favoritism on the earnings of married men then the positive marriage premium must be observed for both self-employed and salaried workers. If married men are more productive than unmarried men, then their greater productivity and their higher earnings should be observed no matter where or how they earn a living. Loh finds that married self-employed men earn less than single self-employed men. This supports the argument that the marriage premium is not due to increased productivity, but occurs because of employer favoritism.

Pfeffer and Ross (1982) suggest two other factors that can cause employers to favor married males. First, married men are rewarded because they conform to social expectations that men should be married and support their families, while unmarried men and married working women are penalized because of differing social

"norms." Second, wives may build better social relations that improve the husbands' standing with supervisors. The latter situation may characterize the military, especially the officers corps.

Jacobsen and Rayack (1996) do not accept the argument that the cause of the marriage premium is employer discrimination based on marital status. Their OLS estimates show that self-employed workers, a group that is not subject to the discriminatory behavior of supervisors, earn less when their wives work in the labor market than when their wives do not.

III. LITERATURE REVIEW

Almost all prior research on marital status shows that married man earn higher wages than unmarried men even after controlling education, work experience, race, age, occupation and similar characteristics. The wage difference caused by marital status is both statistically and economically significant. The previous studies claim that the wage differential between comparable married man and men who never married ranges between 10 and 40 percent. This chapter reviews and critiques eight previous studies.

A. HILL

Among the existing studies analyzing the marriage premium, the first widely cited study was conducted by Hill (1979). She uses cross-sectional data from the 1976 Panel Study of Income Dynamics (PSID). The sample consists of 5,212 household heads and wives ages 18-64 who worked at least 500 hours in 1975. She estimates 22-31 percent higher wages for married men than men who never married. She also estimates higher coefficients for widowed, divorced, or separated men. Married women on the average worked considerably less compared to married man in the sample she used. She also shows that married women are less stable workers than single women. Hill finds no evidence of a significant wage effect of marriage among women.

In her regression model, Hill tries to determine whether marital status is one of the worker characteristics that increases productivity or whether it is just a variable that captures some other unobservable characteristics that are correlated with productivity. In her regression equation, she controls for numerous productivity-related aspects of workers' qualifications in terms of labor force attachment, work history and on-the-job training. She included control variables such as work experience, job tenure, firm-provided training, health status, occupation, industry, annual work hours, and number of children in four successive regression equations. As she adds more variables that are correlated with productivity in the regression models, the effects of marital status on wages remain remarkably stable. Thus, her findings provide evidence against the claim that the marriage premium reflects the unobserved productivity difference that favors married men. The findings contradict the selection hypothesis which argues that the marriage premium is due to the selection of 'high qualified' workers in marriage.

Hill's results also show that workers with greater familial responsibilities, such as being married with a large number of children, receive higher wages than workers with fewer responsibilities. She says that the higher wages for more responsible married males could be productivity related, or they may be willing to work harder. Alternatively, married males may simply take unpleasant jobs in order to earn more money and the marital premium reflects this compensating wage differential. She makes some other assumptions about the wage differential based on marital status. She says that if the wage differential does not reflect an increase in productivity, it may either be that employers favor married workers or that married workers are more adamant about demanding higher wages from employers.

Using cross-sectional data is one major weakness of Hill's study. Without using longitudinal data it is impossible to control for unobservable individual fixed effects. Later studies were able to exploit longitudinal data.

B. KENNY

Kenny (1983) uses retrospective data from the Coleman-Rossi Retrospective Life Histories Study, which is a survey of 1589 men, ranging in age from 30 to 40. The respondents were questioned about the history of their employment, marital status, educational attainment, and other characteristics in 1969. The average length of marriage in the sample is 10 years. He finds that married males receive 17 to 20 percent higher wages than single males even when differences in educational attainment, experience, and race are controlled. He also finds that wages increase more for a man while married than while not married. He attributes this wage differential to additional investment in human capital that occurs during marriage.

He makes several arguments about why married men may invest more in human capital than single men. First, he cites Becker's (1973, 1981) specialization hypothesis; "marriage makes it worthwhile for the high wage spouse (e.g., the male) to spend more hours earning money and for the low wage spouse (e.g., the female) to spend additional time in household production" (p. 224). His other explanation for why married men make bigger investments in training is that since married males anticipate working longer during their lives, they have more time to reap the benefits of greater training. As a result, the marginal cost of hourly investment in human capital is cheaper for married men.

In the remaining part of his study, Kenny mainly tries to determine whether a male accumulates human capital more rapidly while married than while single. He uses an equation to calculate the difference between the growth rate in wages when married and the growth rate in wages when single as a function of investment in human capital:

$$(\ln W_{v+1}-\ln W_v) - (\ln W_{s+1}-\ln W_s) = m_v - b(v-s) + [(\ln\alpha_{v+1} - \ln\alpha_v) - (\ln\alpha_{s+1} - \ln\alpha_s)]$$

The left side of the equation shows changes in the log of the wage per month during the time married and single, m_v represents the speed of accumulation of human capital during the months married, v is the age when he marries, s is the age when he was single, $(\ln\alpha_{v+1} - \ln\alpha_v)$ is the unit of human capital change during the months married, and $(\ln\alpha_{s+1} - \ln\alpha_s)$ is the unit of human capital change during the months single. Based on estimates of this equation, the results show that the value of m_v is .00154 and significant at .10. Kenny claims that this result shows that human capital is accumulated more rapidly when a male is married than when that same male is single, all other things being equal.

Finally, Kenny formulates an equation to examine the hypothesis that a married man makes more investments in human capital since investing is cheaper for him compared to a single man. The logic behind this theory is that a married man is able to borrow at a lower cost from a wife than from other sources to finance his investment in human capital. After the results, he concludes that the level of additional investment in human capital during marriage by a man is positively correlated with the time that he spends in the labor force while married.

The weakness of Kenny's study is that he does not provide concrete evidence to support his claims. As Korenman and Neumark (1991) point out, the observed wage differentials could be caused by employer favoritism as well as by increased investment in human capital.

C. NAKOSTEEN AND ZIMMER

Nakosteen and Zimmer (1987) cite the two main explanations for the marriage premium. The first one is that marriage creates incentives for men to specialize in market work, and the second one is that during marriage men make more investments in human capital. However, they claim that there is a possibility of correlation between factors that

influence both marital status and earnings but remain unobserved, and thus cause biased estimates of the marriage premium.

They use data extracted from the Michigan Panel Survey of Income Dynamics based on a sample of 576 male workers. The sample they use consists of very young men between the ages of 18 and 24. They try to deal with the selection problem that causes biased estimates of marriage due to unobservable characteristics of married workers that are correlated with higher wages. They describe the problem as follows:

A possibility exists that marital status is determined stochastically by a process whose random unobservable component is correlated with unobservables in the wage/earnings function. In such a case, conventional least squares estimates of the wage function, in particular the marital status coefficient and its standard error, are biased and inconsistent (p. 250).

Nakosteen and Zimmer claim that endogeneity arises in conventional least squares estimations because each individual self-selects into a chosen status in accordance with some stochastic sorting mechanism. Moreover, endogenous sorting manifests itself in a manner that cannot be causally observed. To deal with this problem, they use two-stage models in which endogeneity between marital status and earnings are allowed. In the first equation, they use marital status as a function of explanatory variables along with a random disturbance term representing unobservable factors in the determination of marital status. In this marital status equation they include the log of earnings, which is inserted from the second equation, a set of predetermined family background variables such as each parent's educational attainment, number of siblings, and a dummy indicator for each and the presence of older siblings, religion, race, and urban upbringing.

In the second equation, they specify the logarithm of annual earnings as a linear function of human capital and other control variables and a random disturbance term. In their earnings equation they included schooling, experience, a quadratic experience term, and a dummy variable for veteran status and for race. The reason for building this two-stage model is to include marital status in a separate equation, and thus allow the outcome to alter the structure of the earnings equation. The results of the second equation show

that marital status fails to emerge as a source of enhanced earnings when the model is estimated in a manner that addresses the potential for endogenous selection. They conclude that the effect of marriage on wages disappears when the model is estimated free of selection bias.

Since their sample consists of very young men, they recommend trying to replicate their findings with observations on older men. They also recommend extending the reasoning to other determinants of earnings such as the role of health, language characteristics, and religious affiliation.

D. KORENMAN AND NEUMARK

Korenman and Neumark (1991) try to determine whether marriage really makes men more productive. In the first part of their study, they use data from the National Longitudinal Survey of Young Men. The sample consists of men from 14 to 24 in 1966, and each individual is followed for 15 years. The sample is restricted to white men who completed school by 1976. The sample size is 1,541. The sample statistics show that non-wage characteristics differ according to a man's marital status. Married men in the sample are older and they have more work experience than single men. On the other hand, single men have completed more years of schooling but on average they work less than married men.

To eliminate the effects of unobservable, individual-specific factors that correlate with high wages and cause a bias in the marriage dummy coefficient, they estimated a model aimed to remove the individual fixed effects. They define the true model as:

$$Ln(W_{it})=\alpha X_{it} + \gamma\, MST_{it} + A_i + \varepsilon_{it}$$

where W_{it} is the wage of individual i in year t, X_{it} is observable characteristics of individual i in year t, A_i is unobservable characteristics of individual i, and MST_{it} is marital status dummy variable of individual i in year t. The selection bias hypothesis claims that there is a positive correlation between MST_{it} and A_i causing an upwardly biased estimate of γ when the model is estimated by least squares. Korenman and Neumark (KN) use the following equation as a solution to this problem.

$$Ln(W_{it}) - Ln(W_{i'}) =\alpha(X_{it} - X_{i'}) + \gamma\,(MST_{it} - MST_{i'}) + \nu_{it}$$

where, for any variable Z, the mean of Z for individual *i* across the years *t* of the survey is denoted $Z_{i'}$.

After controlling for these individual-specific characteristics, their model still showed that a significant marriage premium exists. They conclude that less than 20% of the marriage premium is associated with fixed unobservable characteristics of individuals that are positively correlated with both marriage and wages, and that the remainder of the marriage wage premium is due to productivity-enhancing effects of marriage.

However, the previous problem that existed in Kenny's (1983) study holds true for their conclusion: They cannot rule out other explanations such as employer favoritism. They rule out the selection bias hypothesis by showing that the marriage premium continues to grow as the number of years a man is married increases. If the higher wages of married men were due to the selection of men with higher wages in a marriage, then the higher wages of married men would not increase systematically as the years they have been married increase. This indicates that other factors still affect the wages of married men rather than just selection into marriage.

In the second part of their paper, KN analyze the marriage premium by using company-level data from a large U.S. manufacturing firm. The data are described in detail in Medoff and Abraham (1981). The data consists of 8,235 white male managers and professionals (serving in very homogeneous occupations) working within a single firm in 1976. The benefit of using this data file is that it automatically controls for important characteristics of workers and jobs that vary widely across individuals in national data sets where workers are employed in many different firms. The other benefit of this company-level data is they contain supervisor performance ratings, which provide a second measure of worker performance. Each worker's performance in the firm is rated on a six-point scale annually by his immediate supervisor. Additionally, each worker is ranked relative to other workers doing similar jobs. One other performance measure that is used by KN is the employee's job grade. The company assigns workers to job grades according to their relative value to the company. Thus, the wages of workers in any given job grade are is very close to each other.

Simple statistics show that married workers earn annually 25 percent more than single workers ($26,873 to $21,384 in 1976). KN also show that married workers occupy higher job grades in higher proportions than single workers do. 37 percent of the workers are in the 'highest two job quartiles' group. 38 percent of this group is married, while 17 percent is single. KN estimate the marriage premium for this company's workers by using OLS techniques controlling for pre-company experience and its square, company service and its square, and dummy variables for region and education. The results show that married workers earn 12 percent more annually than single workers do. When they control for job grade in this equation, the marriage premium decreases to only 2.5 percent, since wages of all workers in any given grade are very close to each other.

Then, KN try to determine whether the higher grades of married men are due to married workers' older age and their greater job experience (married workers in the company have 11.5 years more company service than single workers), or the result of increased productivity due to marriage. To determine the answer they estimate the promotion probabilities of workers based on their marital status with multinomial logit models. In these models they use a sample of "recent hires" (280 workers with two or fewer years of company service) controlling for pre-company experience and its square, company service and its square, and dummy variables for region, education, and job grade. The results show that married male workers are more likely to receive higher performance ratings than single male workers and, consequently, that the probability of promotion for married male workers is higher (10.5 percent) than that of single male workers.

KN conclude that since married male workers are more productive and that they receive higher performance ratings from their supervisors. The higher ratings cause them to be promoted faster. As a result, the higher job grades enable them to earn more than single male workers.

E. LOH

Loh (1996) uses data from the 1990 survey of the National Longitudinal Survey of Youth Labor Market Experience (NLSY). The sample consisted of 2,626 young men and women between 14 and 22 years of age when they were first interviewed in 1979. Loh, in his paper, claims that previous studies that attribute the marriage premium to

increased productivity are all inconclusive because their findings do not rule out the alternative explanations of, for instance, the probability that employers discriminate in favor of married men.

At first, he reports OLS benchmark estimates of wage differences associated with being married, divorced or separated. He shows that married men earn 9.1 percent more in hourly wages than single men holding education, tenure, unemployment rate, region, and other variables constant. He says that this marriage premium does not change significantly when adding controls for total hours worked, and the presence of children less than six years old. The marriage premium of 9.1 percent is similar to the cross-sectional estimate of 11 percent in Korenman and Neumark (1991), who use similar data from NLS young men data. These marriage premium estimates are smaller than those reported elsewhere. For example, Hill (1979) reports estimates between 22 percent and 31 percent for PSID males. One reason for finding different marriage premiums may be the choice of the wage rates used in the models. Loh, and Korenman and Neumark use hourly wages as the dependent variables whereas Hill uses the ratio of annual earnings to annual hours worked.

In his study, Loh tests two popular marriage premium theories. The first hypothesis tested by Loh is Becker's (1973, 1981) theory suggesting that married male workers specialize in labor market work while their wives specialize in household production. From this theory, he concludes

> if work hours in the market and in the home are substitutes, women with more market work hours must be relatively less specialized to home production than women with fewer market work hours. As a result, the Becker model predicts smaller human capital investment by men in the former households. They should correspondingly receive a lower marriage wage premium as well. (p. 578)

To test this theory, he accumulates the total number of weeks worked by the wife over the duration of the marriage up to 1989 and then divides this total into six lengths represented by six dummy variables (0 years, <2 years, 2-4 years, 4-6 years, 6-8 years, >8 years), which are included in his regression model. His results show that in contrast to the prediction of the specialization theory, married men with wives who devote more time to the labor market receive a higher marriage premium than those whose wives do not work

at all, holding marriage length and other variables constant. This finding thus contradicts the hypothesis that married men with non-working wives have greater opportunities to accumulate human capital.

Loh was also able to reject the specialization theory by looking at the problem from another view of point. He claims that if this theory is true, then currently married men who cohabitated with their present wife before marriage should receive a higher marriage premium, all else being constant. He gives two reasons for this. First, even if no division of labor or specialization occurred during cohabitation, the information gathered by the partners about each other provides them with a head start on the specialization process when they get married. Second, if greater specialization occurred during cohabitation and increased investments in human capital were made, then married men who cohabited with their wives before marriage must receive a higher marriage premium compared to the ones who did not cohabitate. To test this theory he adds two dummy variables measuring living arrangements of sample individuals in the model. The first variable indicates those currently married men who lived with their wives before they were married. The second variable indicates those presently not married but who are living with a woman as a partner. The results show that men in both groups receive the same marriage premium as married men who did not live with their wives before marriage. He claims that these findings contradict the specialization theory.

Secondly, Loh tests the theory that employers favor married men as workers though there are no actual productivity differences. He reasons that if this theory is not true, then the positive marriage premium should be observed for both married self-employed and salaried workers. Also, if marriage really makes men more productive, then a positive marriage premium should be observed for both self-employed and salaried married men. If not, then the source of the marriage premium is employer favoritism. He builds a model including a self-employed dummy and an interaction between the self-employed and married dummy. He finds that self-employed men who are married earn 11.89 percent less than self-employed men who are single. This shows evidence that marriage premium is not due to increased productivity, but could be due to employer favoritism.

Loh also shows that there is a positive relationship between the education level of the wife and the husband's marriage premium. This finding supports the suggestion made by Pfeffer and Ross (1982) that wives may build better social relations that improve the husbands' standing with supervisors.

F. GRAY

Gray (1997) conducted a very extensive study of the marriage premium and reviewed all the previous studies and hypotheses discussed above. He uses two different data sets for his study. One is the National Longitudinal Survey (NLS), and the other is the National Longitudinal Survey of Youth (NLSY). He estimates models using both cross-sectional and longitudinal data for two different time periods. The first period is 1976-1980, and the second period is 1989-1993. He analyzes the marriage wage differential for white young men aged 24 to 31. The dependent variable of the models is hourly wages.

Gray presents summary statistics for each sample. The summary statistics reveal that the characteristics of the sample are similar to the samples used by other researchers. Married men have higher hourly wages, are older, have less accumulated education, and have more years of work experience than men who never married. His summary statistics also makes it possible to compare the change in the effects of marriage from 1976 to 1989. The table shows that besides a decrease in real wages irrespective of marital status, the wage difference associated with marriage also decreased. In 1976, the average hourly wage of men who never married was 13 percent lower than the average hourly wage of married men. By 1989, the hourly wage differential between married and men who never married had decreased to 9 percent. During the period this fall in the marriage wage premium was occurring the mean labor market hours worked by wives increased from 14.6 hours per week in 1976 to 28.3 hours per week in 1989, signaling a decline in specialization within households.

Gray tests whether the marital status premium has been decreasing over time, and tries to find underlying reasons for such a decrease with both cross-sectional and longitudinal data. For cross-sectional wage equation estimates, he uses the pooled NLS and NLSY samples. He mentions the probable positive correlation between individual *i*'s time-invariant unobserved characteristics captured by the error term and the marital status

dummy. To address this unobservable variable bias in the longitudinal equation, he uses a within-group estimator that eliminates the latent error term and any potential correlations between the error term and the other independent variables.

The results show that the decline in the marriage wage premium over time increases after controlling for individual characteristics. However, Gray does not explain which individual characteristics are controlled for in his equations. The cross-sectional equation results suggest that during the 1976-1980 period, the marital status wage difference is 11 percent more for married men than men who never married. However, during 1989-1993, this wage difference dropped to 6 percent. This is a 45 percent decrease between the two periods. The results from the longitudinal equation suggest that the marriage wage premium is 9 percent for the first period, but almost disappears for the second period. Since the longitudinal equation eliminates fixed individual characteristics, the author suggests that the decrease in the marriage premium resulting from this equation is evidence that wages and the probability of marriage are positively correlated with an individual's fixed unobservable characteristics.

The relationship between the marriage premium and marriage tenure also are analyzed in the paper. Gray cites two previous findings that suggest a positive relationship between the years married and the marriage premium. Kenny (1982) argues that the marriage premium increases as the number of years married increases. Korenman and Neumark (1991) find that the marriage premium is quadratic in the total number of years a man has been married. These findings suggest that marriage has productivity-enhancing effects. Gray's findings from the cross-sectional equation in which cross-sectional wages increase by 2.4 percent per year during the first few years of marriage, support this hypothesis. However, Gray does not attribute this finding to a positive relationship between marital tenure and productivity. He says that this increase in marital wage premium dependent on marital tenure may also result from the probability that more years married may be correlated with men's unobservable ability as well.

He also analyzes the hypothesis that the marriage premium is due to specialization in marriage with the spouse working in the market place devoting more time to his job while the spouse specializes household production. If this hypothesis is true then the

marriage wage premium should be higher for those whose wives do not work or work less in the paid labor market. He finds evidence to support this hypothesis for the 1976-1980 period. The cross-sectional equation results show 1.8 percentage points lower wage differential for each additional ten hours per week a wife worked in the labor market. The longitudinal estimates show that those men whose wives work in the labor market full-time earn 5% less than those whose wives work in home production. However, interestingly for the 1989-1993 period, the results show a significant decrease for this wage differential depending on specialization within the marriage. For this second period, longitudinal estimates show that there is no wage difference between two married men due to the hours their wives work in the labor market. The explanation suggested by the author for these later findings is that "if the husbands are devoting more time and energy to home production activities independent of the time their wives spend in paid employment, then decreased specialization could explain the fall in the productivity-enhancing effects of marriage." (p. 498)

Gray concludes that the marriage premium paid to young male workers decreased dramatically, or by more than 40 percent between the late 1970s and the early 1990s. The most apparent reason for this decline is less specialization taking place within marriages rather than any decrease in the return to specialization.

G. ANDERSON AND KRIEG

The only study we were able to find which analyzes the marriage premium in the U.S. military was done by Anderson and Krieg (2000), which analyzes the marriage premium for U.S. first-term enlisted Marines. They use a data set from a survey of 65,535 Marines provided by Headquarters, U.S. Marine Corps, Manpower and Reserve Affairs, and Manpower Plans and Policy Division. Citing from Beindorf (1999), they show that married Marines have a 44.2 percent lower attrition rate, and a 58 percent lower all misconduct-related discharge rate than single Marine counterparts. They cite also that 28.2 percent of married Marines reenlist while only 14.1 percent of single Marines reenlist. Married Marines are also on average one year older, have served in the military approximately four months longer, have slightly lower Armed Forces Qualifying Test (AFQT) and physical fitness test (PFT) scores, and generally are evaluated better by their supervisors. Married Marines have slightly higher ranks on average than single Marines.

They use two measures of performance in their analysis: the probability of promotion to the next grade, and supervisors' evaluation scores. They use a probit model to calculate the probability of promotion to E-3 and E-4 during the first term. They find that the promotion probability of married Marines is higher than for single Marines. For example, married Marines without dependents have a 4.7 percent higher promotion probability to E-4 than single Marines. The model results show that married Marines without dependents have a higher promotion probability than married Marines with dependents. They suggest this finding is evidence that marriage premium is not due to supervisors' favoritism for married workers. If supervisors are rewarding married workers just because they are married, their perception will not change whether their married workers have dependents or not. They interpret one result of this probit model differently from civilian labor market economists. Their model shows that divorced Marines still have a greater probability of being promoted than single Marines. They do not attribute this finding as contrary to the household specialization argument. They argue, however, that divorced Marines are different from workers who are divorced in the civilian labor market. First, divorced Marines receive a great amount of support from counseling services in the Marine Corps. Second, most of the divorced Marines live on military bases where they face less housework than divorced civilian workers.

Anderson and Krieg use an ordinary least squares model to calculate the effect of marital status on supervisors' performance evaluation scores. They use Marines' proficiency (PRO) and conduct (CON) scores as dependent variables. Supervisors use PRO scores to evaluate technical skills, specialized knowledge, and traits like leadership, initiative, and dependability. CON scores are used to measure Marines' military-specific qualifications such as military bearing, attitude, obedience, and integrity. The regression results show that married Marines receive higher evolution numbers in both PRO and CON scores than single Marines.

Anderson and Krieg test the relationship between the two performance indicators and find a positive relationship between them. The higher the evaluation scores a Marine receives from his supervisor, the more likely he will be promoted. They conclude that the cause of the marriage premium is supervisors' evaluations that consistently rank married Marines higher than their single counterparts. They do not show a specific reason why

supervisors rate married Marines higher. They say that the reason may either be higher productivity of married Marines, which is either increased by marriage, or that more productive Marines marry (selectivity).

H. CHUN AND LEE

Chun and Lee (2001) conducted one of the latest studies analyzing the reasons for why married men earn more. They use data drawn from the Current Population Survey (CPS) March Supplement 1999. The data set they use captures the recent changes in the average age of marriage and household specialization issues. For example, the median age for the first marriage was 23.2 years in 1970 for men and increased to 26.7 years in 1998, indicating an increase in delaying marriage in the late 1990's. Moreover, female labor force participation in the 1990's is higher than in the 1970's. One other advantage of the data set they use is it consists of working males from 18 to 40 years of age. Most of the previous studies use a sample of younger men. Using a sample of older ages could capture the effects of marriage more clearly, since the older sample captures the effects of marrying at older ages. Another advantage of the data set is it contains detailed information about the wife's working conditions in the market place and some other family characteristics.

Summary statistics in Chun and Lee show that the average hourly wages of married men is 30 percent higher than that of men who never married. An unusual feature of their data is that married men have more formal education than men who never married. Previous studies using data from older periods find that married men have less formal schooling than men who never married. However, Chun and Lee show that married men in their sample who have at least some college education average 6 percent higher wages then men who never married having at least some college education.

Chun and Lee first show evidence that the marriage premium cannot be attributed to the unobservable individual characteristics that cause the selection of certain types of males into marriage and an upward bias to the marriage dummy variable. Second, they show that the marriage premium is negatively correlated with the hours the wife works in the market place. They argue that this correlation suggests the argument that marriage causes married men to specialize in market work and makes them more productive.

In their first model, they use a switching regression equation with endogenous marriage selection. With this equation, which is different from previous studies, they deal not only with the problems caused by the correlation between marital status and wages, but also with biases caused by the marriage selection process, which are not necessarily related to the wages of married men (such as the wife's working hours which is an index of marriage market conditions). Nakosteen and Zimmer (1987) also used a two-stage equation to deal with this problem.

Chun and Lee first predict a 'marriage selection' equation, which includes all variables that are correlated with wages and some variables that are not. They use a wife's predicted working hours as a dependent variable for this equation. In this equation, they use two exogenous variables that are assumed to be correlated with marriage but uncorrelated with the husband's wage equation. The first exogenous variable indicates whether the couple lives with relatives other than their children. The second exogenous variable is the proportion of female employment in the state. After predicting the wife's working hours, they replace actual hours with predicted hours, and they estimate switching regression models with endogenous marriage selection. This model estimates a marriage coefficient of 0.120, which is higher than the coefficient they estimated with OLS techniques, 0.117, which did not control for the correlation between wages and marriage selection.

This result is different from previous studies. In previous studies, controlling for endogeneity reduced the size of the coefficients on the marital status dummy. Based on their finding that unobservable marriage selection criteria are not positively correlated with unmeasurable individual characteristics that cause married men to be more productive, the authors conclude that there is no apparent marriage premium arising from the selection of potentially more successful workers into marriage.

In their second model, Chun and Lee test the specialization argument, which is that marriage increases the productivity by allowing the husband to specialize in market work. They divide the marriage premium into two parts: the positive effect of marriage with the wife not working in the market place, and the marriage premium decrease based on every additional hour a wife works in the market place. They estimate that men whose

wives do not work in the labor market, and thus specialize in household work, earn 31.4% more than men who never married. They also estimate that the marriage premium decreases by 0.6% for each additional hour the wife works outside the home. They compare the earnings of men whose wives are not employed and whose wives have a full time job with the earnings of never-married men. Men whose wives are not employed earn 31% more than men who never married, and the men whose wives have a full-time job earn only 3.4% more than men who never married. They claim that these two findings support the positive relationship between the marriage premium and the degree of specialization of the wife in household work.

I. SUMMARY

Table III-1 summarizes previous research. The table presents the data sample and methodology used as well as results of each study.

Table III-1. Summary of Previous Studies.

Name	Data	Method	Results
Hill (1979)	PSID (1975) N=5,212	OLS	Married men earn 25-30% more even after numerous controls for worker qualifications. Married men with more children receive higher wages.
Kenny (1983)	Coleman-Rossi Retrospective Life Histories Study (1969) N=1,233	OLS	Married men receive 17-20% higher wages than single men after numerous controls. Men's wage growth during their married months is higher than during their unmarried months.
Nakosteen and Zimmer (1987)	PSID (1977) N=576	Two-stage model	The effect of marital status on wages disappears when the model is estimated free from selection bias.
Korenman and Neumark (1991)	National Longitudinal Survey of Young Men (1966-1980) N=1,228 Company-level data (1976) N=8,235	Fixed effects	Married men earn 15% higher hourly wages than men who never married. More than 80% of this differential survives after 'fixed unobservables' are added. Marriage premium continues to grow with each year men have been married. Married workers in single company have 10.5% more probability to promote than single workers.
Loh (1996)	National Longitudinal Survey of Youth Labor Market Experience (1979-1990) N=2,626	Fixed effects	Married men with wives who work receive a higher marriage premium than those whose wives do not work. Self-employed married men earn 12% less then single self-employed men.
Gray (1997)	National Longitudinal Survey, and National Longitudinal Survey of Youth (1966-1993) N=1,248	Fixed effects	The marriage premium to young male workers fell more than 40% between the late 1970's and the early 1990's. During the late 1970's married men whose wives work full-time earn 5% less than those whose wives do not work. During the early 1990's this difference disappears.
Anderson and Krieg (2000)	First term enlisted Marines survey provided by Headquarters U.S. Marine Corps N=44,103	OLS	Married Marines' promotion probability is higher than unmarried Marines. (Married Marines without dependents promotion probability to E-4 is 4.7 percent higher than single Marines' probability.) Married Marines receive higher performance evaluation scores than their single counterparts.(Married E-2 Marines without dependents receive approximately .15 points higher scores (scale is from 0 to 5) than single Marines.)
Chun and Lee (2001)	Current Population Survey (March 1999) N=2,686	Two-stage model	Married men earn 12.4% more per hour than men who never married. This difference does not drop after controlling for individual-specific earning characteristics that are valued in marriage market. Married men whose wives don't work earn 31.4% more per hour than men who never married. This marriage premium decreases as the wives put in more hours working. For example, men whose wives have a full-time job earn only 3.4%more.

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IV. DATA

A. DATA SOURCE

The data for this study includes information about U.S. Navy officers who entered the Navy between 1976 and 1985. The data file is the same file used by Bowman and Mehay (1999) in their study "Graduate Education and Employee Performance: Evidence from Military Personnel." They constructed the database by first incorporating data from the Navy Bureau of Personnel's Promotion History File, which provides information on the promotion of officers to Lieutenant Commander (grade 4). This data was matched with files from the Navy Personnel Research and Development Center that contained information on officers' fitness report prior to the grade 4 promotion review. The matched data file includes information on the marital status of each individual for three different periods in their lives: upon joining the Navy, four years later at the O-3 promotion board, and ten years later at the O-4 promotion board. The data make it possible to track changes in marital status and dependents over time, and to analyze the ensuing effects of these changes. The data file also contains the officer's annual fitness reports, promotion history, and Navy job experiences.

In addition to the main personnel data file, this thesis used additional data that characterized officers' marital status and dependents upon entry to the Navy. The additional data were obtained from the Defense Manpower Data Center and matched to each individual officer in the main data file.

B. NAVY PERSONNEL SYSTEM

The Navy personnel system is mainly characterized by an internal labor market with a vertical hierarchy, no lateral entry, administrative pay setting, and up-or-out promotion (Bowman and Mehay, 1999). The internal labor market consists of clusters of jobs linked to each other by the skills and capacities required. The military is also characterized by promotion tournaments, which are often used within the context of internal labor markets to motivate workers (Ehrenberg and Smith, 2000).

1. Navy Officer Promotions

The Navy's officer corps is structured like a pyramid. The wide personnel base consists of junior officers and the pyramid shrinks with each successive upward

movement through the rank structure. Personnel inventory decreases severely near the peak at the flag officer level and the Chief of Naval Operations occupies the top position.

The Navy's promotion system is vacancy driven. The Defense Officer Personnel Management Act (DOPMA) constrains the number of officers in the grades of O-4 to O-6 that each service might retain as a percentage of its officer corps (RAND, 1994). Promotion plans are developed annually to determine the projected need for officers in each grade and designator.

Selection opportunity has three components: authorized officer strength, promotion flow point and selection opportunity (percentage). Authorized officer strength is the total number of officers authorized that will serve in the Navy for each year. Promotion flow point is the average number of years of service commissioned officers must have to be promoted to the next higher grade. Selection opportunity is the ratio of the number of higher-grade vacancies to the number of lower-grade billets. Along with these higher-grade vacancies, the selection percentage guidelines are used to determine who is "in zone" for selection in the lower-grade. For example, if planners calculate the need for 500 lieutenant commanders in the unrestricted line (URL), and 50 percent is desired for the selection opportunity, then the zone must include 1000 URL lieutenants. Table IV.1 shows promotion flow points and selection percentages for Navy officers. (The Navy Media Center, 1997)

Table IV.1. Promotion Flow Points.

To Grade of	Promotion Flow Point	Selection Percentages
LTJG	2 Years	100% (if fully qualified)
LT	4 Years	95-100%
LCDR	9 to 11 Years	70 to 90%
CDR	15 to 17 Years	60 to 80%
CAPT	21 to 23 Years	40 to 60%

From: The Navy Media Center, *All Hands*, August, 1997, pp. 89-90.

Promotion boards for each competitive category select officers for promotion. Selection boards are composed of officers who have shown outstanding quality of

performance, maturity, judgment, naval background and experience. Each member takes an oath to consider all eligible officers without partiality and to recommend for promotion only those officers who are "best qualified." (The Navy Media Center, 1997)

2. Up-or-Out Systems

Up-or-out promotion structures are commonly used in universities, professional service firms, and the military. In an up-or-out system, employees are evaluated after observing their performance for a period of time. Workers who perform above a certain performance criteria are promoted while those failing to make the grade are dismissed from the organization. This system combines the benefit of a merit-based system that rewards 'better' performers and that drops poor performers from the candidate pool. (Phelan and Lin, 2000)

The up-or-out structure is used in the Navy by commissioning officers into the Navy at the beginning of their careers and then forcing or inducing them to separate on some basis, such as failure to progress in grade, at a later point. This structure provides the Navy with continued good performance in the lower grades and retention of the best-performing officer. However, forcing out officers who perform much more poorly later and substituting new officers disrupts organizations and causes a high turnover rate that increases training costs. Moreover, the military is the only organization in which the profession of being an officer can be practiced. A doctor can leave one hospital and start working at another hospital, but an officer cannot work as an officer if forced to leave the military. Forced separation terminates the ability of an officer to practice his or her profession. (Rand, 1994)

3. Promotion Tournaments

The Navy uses a kind of promotion tournament system to motivate officers. "Tournaments have three main features: who will win is uncertain, the winner is selected based on *relative* performance (that is, performance compared to that of the other "contestants"), and the rewards are concentrated in the hands of the winner, so there is a big difference between winning and losing." In this system, only the winners get the prize at the end of their careers. Furthermore, once the winners are known, the losers might lose their motivation to work, while the winners may "rest on their laurels." One other problem related to this system is that employees may not be willing to enter this

tournament because what they might lose, given that they did not win, comes at a very high price (Ehrenberg and Smith, 2000).

Lazear and Rosen (1981) compare the rank-ordered tournaments compensation system with the piece rate compensation system that is based on individual output and effort. They find that employees in tournament systems are at least motivated as much as in a piece rate system. They suggest that the large salaries of higher positions in the firms may provide incentives for all workers to work hard to increase their chance of winning one of the top positions. Furthermore, compensating workers on the basis of their relative performance in the firm provides a lower cost method of measuring and monitoring the relative positions of workers instead of measuring the level of each worker's output directly. Another advantage of a rank-ordered tournaments system is that it eliminates income variation. Every worker receives the same earnings at the same rank.

C. NAVY OFFICER'S FAMILY LIFE

The family life of an officer is different in some aspects from the family life of a civilian worker. First of all, during the early stages of a naval officer's career, typically from Ensign to Lieutenant Junior Grade, the young careerist must construct his own identity through work and adapt to the demands of the Navy. Junior officers have to do a lot of "dirty work" in the unit and must dedicate most of their time to the Navy. On the other hand, during this time the Navy tries to determine whether the new officers are suited for future missions.

Moreover, if naval officers are married during this time, they must develop a work-family life with their spouses. Building this new life may be more difficult than it was for their parents or in civilian careers. The difficulty is not only the longer hours the officers must work, but also the frequency at which they leave home for extended tours at sea. Since this early career period is the worst in terms of hardships, young married officers concentrate most of their time on their jobs instead of their spouses. The problem during this period is to convert the spouse to the Navy way of life, especially when the spouse is completely unacquainted with such a lifestyle

The policy of frequent moves also causes two big problems for an officer's family. One problem arises concerning the spouse's job. It is difficult for spouses to find stable

jobs when moving so frequently. The other problem arises when the officer's children reach school age and frequent moves require children to change schools.

At this early career stage several types of officers overcome the problems discussed above more successfully. One advantaged group is staff officers who experience less sea duty and family separation compared to line officers. Another group consists of bachelors or childless couples whose relative flexibility decreases such problems. The other group is those married couples where both spouses are in the Navy (Derr, 1979).

In mid-career, which typically is the Lieutenant-Lieutenant Commander ranks, the officers have completed 8 to 14 years of service, and are about 27-36 years of age. At this phase, the officers are more secure in their careers having already established technical competence. During this middle career stage, officers usually start questioning for the first time how they have developed as an adult. During this state, they confront feelings of imbalance or a need to develop their non-work identity, which might include being better parents, being a more considerate and loving spouse, and pursing hobbies. At the same time, their career frequently demands very hard work at this stage because of the up-or-out policy of being promoted to Lieutenant Commander or being forced to leave the Navy. Since fitness reports up to this up-or-out decision point are critical, officers are not willing to risk distractions and non-work orientations.

One other characteristic of the middle stage for officer families is having young children at home or in school. During these years, child rearing is more demanding, and usually one spouse is looking for help from his or her partner.

By late mid-career, officers are expected to accomplish most of their tasks by managing subordinates, or by working with friends and seniors. Advancement after this stage will depend not only on on-the-job productivity, but also on many informal, and social criteria related to the behavior of spouses. The role of the spouse, and usually the wife, changes from unquestioned supporter to that of an active manager or participator in the family’s social obligations.

During the late career phase of Commander, Captain, and Admiral, both the officer and the spouse experience executive roles with increased expectations and

responsibilities. They demand to move less to provide more stability for their older children. They also start to think about the transformation from active military life to a retirement life.

In summary, the three career phases in the family life of an officer are different, and the productivity of an officer is strongly affected by the dynamics of family life in these stages. During each phase, support of the spouse affects the performance of the officer (Derr, 1979).

D. A COMPARISON OF CIVILIAN MARKET AND NAVY WORKING ENVIRONMENTS AND PERFORMANCE CRITERIA

The characteristics of the environment used in this study are much different from the civilian sector. Of course, there are both strengths and weaknesses in using a data set of Navy officers compared to data from a civilian environment. One advantage of using data on officers is that, for the Navy, the set of jobs performed, the levels of difficulty, and the career paths of officers are very similar in each community.

Second, training opportunities, ages, and the physical fitness status of military officers are automatically controlled because all officers in the same specialty chose similar career paths. They are in a very close age range in the paygrades represented in our data, and the military organization requires all officers to maintain good physical fitness. The officers have many common characteristics. At a specific time and pay grade, and for a specific specialty, average ages, formal and firm-specific training attained, physical fitness, and tests for military life are much more closer to each other than they are for comparable civilian workers. Thus, fewer controls are needed to capture individual-specific unobservable characteristics when estimating a model using officer data. In other words, the unobservable characteristics for officers vary much less than for civilian workers. As discussed earlier, prior researchers who attribute the marriage premium to self-selection bias claim that the different unobservable characteristics of each individual make it impossible to estimate unbiased parameters. In addition, the working environment automatically becomes more observable since the supervisors' evaluation and the promotion of an officer only occurs within his/her specialty, and the effects of marital status and family structure on productivity will be reflected by the supervisors' evaluation and help determine promotion.

Third, job rotation in the military often affects an officer's performance appraisal and it can thus be more objective. A different supervisor every two or three years allows the officers to be evaluated by different supervisors. This reduces supervisor-specific evaluation bias. Muchinsky (1999) discusses some of these rating biases: Halo errors, leniency errors, and central tendency errors.

Halo errors are biases caused by the supervisor's general feeling about an employee. The supervisor likes or dislikes one feature of an employee, and then tends to generalize the employee's performance based on this feature. For example, if the supervisor's criterion for evaluation of the officer is whether or not the officer has been disciplined, upward biased scores for all performance ratings for the officers thought to have been 'disciplined' will be given. Leniency errors are another type of rating bias. Supervisors can be characterized by the leniency of their appraisals. Some supervisors tend to give higher scores on average while others tend to give lower scores. The last type or central-tendency error refers to a supervisor's tendency to give average scores for everybody and to avoid giving extremely high or low scores.

This study will use the 'recommendation for accelerated promotion' element in the supervisor's evaluation and the promotion outcome to grade 4 as proxies for 'on-the-job productivity.' Therefore, the more objective the evaluation and the promotion outcome, the more reliable the findings of the study will be.

On the other hand, there are some disadvantages to using a population consisting of officers. First, if the supervisor of an organization is the owner of that organization, and the supervisor benefits directly from the profits, then the performance of an employee is more important to that supervisor. In this case, an employee's performance directly affects the gains or losses of the supervisor. Thus, the owner-supervisor cares more about the performance of employees and consequently evaluates them more carefully and more objectively. In addition, supervisors will reward or punish employees quickly. In the military, by contrast, the supervisor may not gain or lose anything directly from the performance of an officer. The supervisors are not owners and the hierarchical structure makes it too bureaucratic to reward or quickly punish an officer. The similarity of

evaluation reports for officers reinforces the impression that supervisors are less concerned about the evaluation of their subordinates.

Second, in the military environment it is difficult to track an officer's accumulated human capital investment because most of the skills needed to perform their jobs are gained from military training programs. Moreover, officers are less free to invest in human capital on their own. This feature of the military may have a positive aspect, though, in that firm-specific training is similar for all officers.

Third, though the two proxies of fitness reports and promotion are available to measure an officer's productivity, they are indirect measures compared to civilian studies. Fourth, as one of two proxies to measure an officer's productivity, promotion outcomes might have a systematic flaw caused by the 'up-or-out' policy. Even though officers successfully perform their jobs, they may be forced to leave the military if they are not within the number of promotion billets required. Just the opposite may also be true. Even though the officer is not appropriate for the next pay grade, he or she may be promoted due to a large number of vacancies. In both cases, the promotion outcome is not an ideal indication of an officer's productivity.

E. DATA DESCRIPTION

The U.S. Navy has basically two categories of officers – line officers and staff officers. The line officer group is composed of the unrestricted line officers, which include surface, air, submarine, and special warfare operations, and the restricted line officers, which include specialists in engineering, maintenance, intelligence and fleet support. The staff officer group, consisting of Chaplain, Civil Engineer, Judge Advocate General, Medical, and Supply, serves in professional support functions. However, "within each specialty the set of jobs performed, the level of difficulty of the jobs, and career paths are similar; also, supervisors' evaluations and promotion are based solely on performance within that specific community" (Bowman and Mehay, 1999).

Based on the fact that the careers and job environment of two categories of officers differ, it can be assumed that when compared to staff officers, line officers (except restricted line officers) are more likely to be separated from their family for longer periods of time due to deployments at sea. Family separation will affect both the

employment opportunities of officer's spouses and the couple's ability to specialize within the household. Consequently, the decision was made to separate officers into two groups; (1) Unrestricted line officers (URL), and (2) Staff and restricted line officers (STF/RL). The data file for the URL group contains 28,983 observations, while the STF/RL group consists of 5,357 observations.

Table IV.2 provides names and descriptions of the analysis variables used in the multivariate models. Coding for some variables was imported from Bowman and Mehay's data file, while other coding was created by the authors of this thesis.

Table IV.2. Description of Variables.

Variable Name	Variable Description
PCTRAP12	Percentage of 'early promotion recommendation' at grades 1 and 2 (0 – 100)
PCTRAP3	Percentage of 'early promotion recommendation' at grade 3 (0 – 100)
PROMO	Selection for promotion to grade 4 (1: promotee, 0: non-promotee)
STAY	Stayer at O4 promotion review (1: stayer, 0: leaver)
MARRIED0	Marital status at entry (1: married, 0: single)
MARRIED1	Marital status at O3 (1: married, 0: single)
MARRIED2	Marital status at O4 (1: married, 0: single)
AGE	Entry age (in years)
PRIOR	Prior service experience as enlisted (1: yes, 0: no)
GRADSCH	Graduate school education (1: yes, 0: no)
GPA	College grade point average (1 – 5)
MILSPS1	Military spouse at O3 (1: yes, 0: no)
MILSPS2	Military spouse at O4 (1: yes, 0: no)
USNA	Commissioning background (1: Naval Academy, 0: Others)
ROTC	Commissioning background (1: Reserve Officer Training Corps, 0: Others)
OCS	Commissioning background (1: Officer Candidate School, 0: Others)
NESEP	Commissioning background (1: Navy Enlisted Scientific Education Program, 0: Others)
WHITE	Ethnicity (1: White, 0: Others)
AFAM	Ethnicity (1: Afro-American, 0: Others)
OTHERS	Ethnicity (1: Non-White and Non-Afam, 0: Others)
GURL	Community (1: General Unrestricted Line, 0: Others)

Table IV.2. Description of Variables (cont).

Variable Name	Variable Description
SWO	Community (1: Surface Warfare, 0: Others)
SUB	Community (1: Submarine, 0: Others)
PILOT	Community (1: Pilot, 0: Others)
NFO	Community (1: Naval Flight, 0: Others)
OTHERURL	Community (1: Other Unrestricted Line, 0: Others)
RL	Community (1: Restricted Line, 0: Others)
STAFF	Community (1: Staff, 0: Others)
FY85	Fiscal Year for O4 promotion review (1: FY85, 0: Others)
FY86	Fiscal Year for O4 promotion review (1: FY86, 0: Others)
FY87	Fiscal Year for O4 promotion review (1: FY87, 0: Others)
FY88	Fiscal Year for O4 promotion review (1: FY88, 0: Others)
FY89	Fiscal Year for O4 promotion review (1: FY89, 0: Others)
FY90	Fiscal Year for O4 promotion review (1: FY90, 0: Others)
FY91	Fiscal Year for O4 promotion review (1: FY91, 0: Others)
FY92	Fiscal Year for O4 promotion review (1: FY92, 0: Others)
FY93	Fiscal Year for O4 promotion review (1: FY93, 0: Others)
FY94	Fiscal Year for O4 promotion review (1: FY94, 0: Others)
FY95	Fiscal Year for O4 promotion review (1: FY95, 0: Others)

Table IV.3 depicts the descriptive statistics of key variables separately for two different communities – URL and STF/RL – and separately for males and females. Since all the previous studies reviewed do not support the wage premium theory across gender, the data was sorted by gender. Therefore, the data are divided into four different groups: URL male officers, URL female officers, STF/RL male officers, and STF/RL female officers. All the values in the table were calculated for each variable without counting observations with missing values for that variable. Therefore, the number of observations varies across the variables.

Table IV.3. Descriptive Statistics of Key Variables Disaggregated by Community and Gender.

Variable	URL Male	STF/RL Male	URL Female	STF/RL Female
PCTRAP12 (%)	30.24 (23,553)[a]	38.41 (4,283)	36.79 (2,344)	39.63 (552)
PCTRAP3 (%)	62.46 (23,428)	68.52 (4,210)	66.66 (2,327)	69.86 (549)
PROMO[b] (ratio)	.7442 (12,387)	.7133 (2,700)	.7599 (1,483)	.7631 (287)
STAY	.4683	.5672	.5859	.4807
MARRIED0	.2096	.3106	.1087	.1173
MARRIED1	.4757	.5323	.1225	.1022
MARRIED2[b]	.8066	.8107	.2785	.3031
AGE	23.17	24.48	23.95	23.23
PRIOR	.1078	.2269	.1031	.0972
GRADSCH	.1241	.1914	.2284	.1809
GPA	2.88	3.12	3.18	3.43
MILSPS1	.0141	.0205	.2280	.2529
MILSPS2[b]	.0299	.0337	.2980	.2822
USNA	.2536	.0994	.0814	.2295
ROTC	.2729	.1450	.1889	.1708
OCS	.4351	.6437	.6989	.5393
NESEP	.0384	.1120	.0308	.0603
WHITE	.9416	.9420	.9048	.9380
AFAM	.0344	.0323	.0790	.0469
OTHERS	.0240	.0256	.0162	.0151
GURL	.0265	N.I.	.8538	N.I.
SWO	.4059	N.I.	.0751	N.I.
SUB	.1675	N.I.	N.I.	N.I.
PILOT	.2585	N.I.	.0450	N.I.
NFO	.1393	N.I.	.0253	N.I.
OTHERURL	.0023	N.I.	.0008	N.I.
RL	N.I.	.3034	N.I.	.4975
STAFF	N.I.	.6966	N.I.	.5025
FY85	.0317	.0574	.0405	.0557
FY86	.1082	.0389	.1099	.0348
FY87	.1132	.1293	.1018	.1080

Table IV.3. Descriptive Statistics of Key Variables Disaggregated by Community and Gender (cont).

Variable	URL Male	STF/RL Male	URL Female	STF/RL Female
FY88	.0848	.0785	.0607	.0836
FY89	.1146	.0648	.1632	.0697
FY90	.1011	.0889	.1214	.0871
FY91	.1129	.1215	.1140	.1429
FY92	.0032	.0781	.0007	.0314
FY93	.0927	.1004	.1038	.0976
FY94	.0924	.0981	.0829	.1150
FY95	.1453	.1441	.1011	.1742

Notes: [a]The numbers in parenthesis show the number of observations in each group excluding those with missing values.

[b]PROMO, MARRIED2, and MILSPS2 are calculated from those who stay to O4 promotion point. All other variables in the table are calculated from those who enter.

N.I.= not included.

URL males have 6 – 8 percent fewer in 'early promotion recommendations' (RAP scores) than STF/RL males for the period of grades 1, 2, and 3, while URL females have approximately 3 percent fewer RAP scores than STF/RL females.

In terms of promotions, URL males have a 3 percent higher promotion probability than STF/RL male officers, while female officers had almost the same promotion rate in each occupational group. Even though STF/RL males gained more 'early promotion recommendations' than URL males, the fact that they have a lower promotion probability seems to reject the correlation between actual promotion and the early promotion recommendation. However, as the early promotion recommendation and the actual selection for promotion occur in different ways, the link between them does not exactly follow a cause and effect relationship. The recommendation for accelerated promotion is made by a single supervisor, whereas the selection for promotion is determined by the projected need for officers in each grade, branch, and specialty considering selection opportunity.

As regards an officer's likelihood to stay in the Navy up to the O4 promotion review point, STF/RL males are 10 percent more likely to stay in the Navy when

compared to URL males, and STF/RL females are 10 percent less likely to stay in the Navy when compared to URL females.

The marital status of each officer group shows that STF/RL officers, when compared to URL officers, are more likely to be married at entry and at O3, while the difference is 5 – 10 percent among males. There are no differences in marriage rates for females. However, marital status differs by gender over time. At the O4 promotion point, approximately 80 percent of males from both groups are married while only 28 and 30 percent of females from the URL and STF/RL groups, respectively, are married. An interesting result is that the relationship between marital status and percentage of 'recommendation for accelerated promotion' (PCTRAP12, PCTRAP3) differs by gender. Among males, STF/RL officers are more likely to be married at entry and at O3 and they received 6 – 8 percent higher RAP scores. Differences are not consistent among females. It is too early to say if there is any important relationship between marital status and productivity by gender, but the simple statistics show that there might be some links between them. This might possibly be connected to specialization issues within a household. For example, male officers would spend less time on household activities after marriage and consequently allocate more time to the job, while female officers might do the opposite in their marriage.

STF/RL males have a higher entry age than URL males. STF/RL females are younger at entry (by .72 years) than URL females. STF/RL males have more enlisted experience than URL males by 12 percent, but there is no difference across communities for females. Since it is reasonable to assume that those with prior enlisted service, and who are older, are better performers than those with no experience, and who are younger, the differentials in AGE and PRIOR, if not controlled for, would create biases in estimating the effect of marriage on productivity.

Regarding advanced education, STF/RL males are 5 percent more likely to have graduate degrees than URL males, but STF/RL females are 7 percent less likely to have graduate degrees than URL females. STF/RL officers have slightly higher grade point averages (GPA) than URL officers. As it is believed that a GPA represents an individual's cognitive skills and that a graduate degree improves an individual's

capability to perform a job, these two variables also need to be controlled to estimate unbiased marriage effects.

As regards the commissioning background, URL males are more likely to be accessed via the USNA and ROTC while STF/RL males are more likely to have entered via OCS and NESEP. URL females are more likely to have entered via ROTC and OCS and STF/RL females are more likely to enter via USNA and NESEP.

Ethnic backgrounds are very similar between URL and STF/RL males. However, URL females are more likely to be Afro-American and less likely to be white than STF/RL females. The ratio of officers who have military spouses are similar between URL and STF/RL officers.

F. ESTIMATES OF MODELS

The analysis of the relationship between marital status and on-the-job productivity will differ in some aspects from previous studies using civilian data. Wages cannot be used as a proxy for the productivity of officers because wages in the military depend solely on grade and years of service. Instead, three proxies will be used to measure an officer's productivity, the same proxies used by Bowman and Mehay (1999) to measure the productivity of Naval officers.

The first two proxies are based on the fitness reports of each officer. The supervisor's annual performance appraisals cover the first 10 years of the officer's career. By the tenth year of their career, officers have been promoted twice. However, promotion outcomes prior to year 10 are not valid for capturing productivity because the first two promotions – to grades 2 and 3 – are almost automatic. Thus, for this 10-year period, the best variable to measure officer productivity is the fitness report. For this period, two performance models will be built, one analyzing fitness reports for the time spent in grades 1 and 2 and one for the time spent in grade 3. These models will analyze the determinants of fitness report scores during these time periods. In particular, they will model the percentage of fitness reports during each interval that receives a 'recommendation for accelerated promotion' (RAP).

The third proxy that will be used to measure an officer's productivity is the outcome of whether he or she is promoted to grade 4 at approximately 10 years of service.

Promotion to grade 4 is very critical for officers since it is an up-or-out point in their career. The productivity of an officer will be measured by using this up-or-out outcome as a dependent variable in a binary logit model.

Table IV.4 tests whether there is a significant difference in the RAP scores for those who were promoted versus those who were not promoted. Simple t-tests show that the mean value of the 'early promotion recommendation' scores is significantly and positively correlated with grade 4 promotion. That is, across all four groups 'promotees' received higher PCTRAP12 scores and higher PCTRAP3 scores than 'non-promotees.' In the case of PCTRAP12, the RAP scores of eventual promotees is nearly double that of eventual non-promotees. For PCTRAP3, the difference narrows, but is still 30 to 50 percent higher. Receiving a higher proportion of RAP scores during one's junior officer career seems to be an important predictor of eventual promotion for all officers.

Table IV.4. T-test of Fitness Reports for Promotees and Fail-to-Selects By Community and Gender[a].

Variable		PCTRAP12		PCTRAP3		N (sample size)
		Mean (%)	T-test[b]	Mean (%)	T-test	
URL Male	Non-promotees	16.60	-31.07 (< .0001)	55.47	-39.69 (< .0001)	2,907
	Promotees	39.55		79.49		9,140
STF/RL Male	Non-promotees	25.54	-15.24 (< .0001)	62.72	-17.67 (< .0001)	719
	Promotees	48.73		83.15		1,915
URL Female	Non-promotees	20.82	-10.46 (< .0001)	52.94	-14.35 (< .0001)	334
	Promotees	41.21		78.96		1,125
STF/RL Female	Non-promotees	29.21	-2.50 (.0131)	62.99	-5.13 (< .0001)	63
	Promotees	42.13		80.92		217

Notes: [a]Sample consists of stayers to O4 promotion review.

[b]T-test between 'Non-promotees' and 'Promotees' groups. The values in parentheses are 'Pr > |t|' for one-tailed test.

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V. METHODOLOGY

As previously discussed, the main objective of this study is to examine whether marital status and family structure (dependents) affect the productivity of U.S. Navy officers. The four major explanations of the marriage premium identified from the literature review are: (1) that it is due to accumulated human capital; (2) that it is due to household specialization; (3) that it is due to selection bias; and (4) that it arises from employer favoritism. As the military environment differs from the civilian sector, in selecting a proxy to measure on-the-job productivity, this study will use a 'recommendation for accelerated promotion' in an officer's fitness reports as a proxy for performance at grades 1 – 3, and promotions to grade 4.

Our study will have six main parts. For all our models, the simple correlations between performance variables and marital and family status variables will be recorded. Then, an attempt will be made to estimate the unbiased marriage premium and family status variable coefficients with regression models and with two-stage models that control for probable selection bias.

In the first part, the marriage premium for U.S. Naval officers will be calculated by dividing marital status into two categories: married and single. Our purpose is to measure whether marriage increases the productivity of officers or not. Previous studies provide support for both alternatives: marriage increases productivity (Hill 1979; Korenman and Neumark 1991; Chun and Lee 2001), and marriage does not increase productivity (Nakosteen and Zimmer 1987; Loh 1996; Cornwell and Rupert 1996). After our main analysis of marital status and productivity, the focus will be on testing some specific hypotheses about the relationship between marital status, family structure and productivity based on the literature review.

The second part of our study will analyze the effects of accumulated years of marriage on the marriage premium. Analysis of the marriage premium based on accumulated marriage years is, as discussed in the literature review chapter, to determine whether the marriage premium increases with the number of years an officer has been married. If the premium is found to increase with the number of years married, it can then

be concluded that at least some portion of marriage premium is due to increased productivity (Kenny 1983; Korenman and Neumark 1991).

The third part of the thesis will measure the unobservable characteristics of officers that are correlated with productivity and selection into marriage. The argument is that workers who are potentially more successful are chosen into marriage by their spouses or they prefer to marry in higher proportions (Nakosteen and Zimmer 1987; Cornwell and Rupert 1996; Ginther and Zavodny 1998).

The fourth part of the thesis will analyze the effects of the number of dependents on performance. Previous studies have hypothesized several possible relationships between productivity and dependent status: On the one hand, more dependents may cause married workers to specialize less due to the need to spend more time in household work. This would result in married officersbeing less productive in market work (Anderson and Krieg 2000). An alternative argument is that more dependents mean greater responsibility, which causes married men to work harder and perform better (Hill 1979). Finally, some analysts have argued that the number of dependents does not affect worker productivity (Korenman and Nuemark 1991).

The fourth part of the thesis will measure the unobservable characteristics of officers that are correlated with productivity and selection into marriage. The argument is that workers who are potentially more successful are chosen into marriage by their spouses or they prefer to marry in higher proportions (Nakosteen and Zimmer 1987; Cornwell and Rupert 1996; Ginther and Zavodny 1998).

In the fifth part of our study, an estimate will be made of whether married officers have attained more graduate school education than the single officers. The hypothesis to test is whether married workers are more successful because they make more investments in human capital (Kenny 1983; Cornwell and Rupert 1997).

For the last part of the thesis, the ‘two-stage model’ will be used to control for unobservables that systematically occur among officers who leave the Navy before the O4 promotion review. This analysis will test for the presence of selection bias.

A. MARRIAGE PREMIUM BASED ON 'SINGLE' AND 'MARRIED'

Table V.1 describes statistics of key variables for each community and gender based on marital status at entry. (Note: As the criteria in classifying single and married is the marital status at entry, many officers who marry at O3 or O4 are treated as single in calculating means of PCTRAP3, PROMO, STAY, etc.) Married officers have higher RAP scores than single officers across community and gender groups. PCTRAP12 is 6 – 8 percent higher and PCTRAP3 is 2 – 7 percent higher for married officers. There is no consistent difference in promotion rates between single and married officers. Compared to single, married URL officers have a 2 – 8 percent higher promotion rate, but STF.RL officers have a 1 – 2 percent lower rate.

As to an officer's likelihood to stay in the Navy up to the O4 promotion review point, married males are 11 – 19 percent more likely to stay in the Navy when compared to single males, and married females are 1 – 2 percent less likely to stay in the Navy compared to single females.

Entry age (AGE), prior enlisted service (PRIOR), advanced education (GRADSCH), and grade point average (GPA) show consistent differentials between single and married officers across community and gender groups. Married officers are 1 – 2 years older than single officers and are 12 – 35 percent more likely to have prior enlisted service. With respect to advanced education, married officers are 4 – 8 percent more likely to have graduate degrees than single officers. Also, married officers have slightly higher grade point averages than single officers for all community and gender groups.

Table V.1. Descriptive Statistics of Key Variables By Marital Status at Entry.

Variable	URL Male		STF/RL Male		URL Female		STF/RL Female	
	Single at entry	Married at entry	Single at entry	Married at entry	Single at entry	Married at entry	Single at entry	Married at entry
PCTRAP12 (%)	28.91 (18,492)[a]	35.38 (5,013)	36.44 (2,906)	42.73 (1,364)	35.88 (2,081)	43.95 (262)	38.77 (486)	45.98 (66)
PCTRAP3 (%)	61.70 (18,382)	65.33 (4,986)	66.49 (2,841)	73.02 (1,355)	66.23 (2,067)	70.09 (259)	69.60 (483)	71.77 (66)
PROMO[b] (ratio)	.7400 (9,289)	.7573 (3,065)	.7234 (1,663)	.6974 (1,031)	.7509 (1,325)	.8344 (157)	.7638 (254)	.7576 (33)
STAY	.4454	.5542	.5084	.6995	.5876	.5709	.4820	.4714
MARRIED1	.3510	.9459	.3497	.9362	.0891	.3964	.0721	.3286
MARRIED2[b]	.7605	.9462	.7300	.9399	.2491	.5287	.2677	.5758
AGE	22.79	24.62	23.65	26.32	23.80	25.25	23.11	24.17
PRIOR	.0640	.2716	.1126	.4600	.0900	.2109	.0702	.3000
GRADSCH	.1165	.1542	.1663	.2469	.2191	.3018	.1765	.2143
GPA	2.87	2.91	3.11	3.14	3.16	3.36	3.42	3.52
MILSPS1	.0146	.0125	.0211	.0190	.2013	.4436	.2258	.4571
MILSPS2[b]	.0364	.0108	.0427	.0194	.2943	.3248	.2835	.2727
USNA	.2795	.1575	.1195	.0529	.0865	.0400	.2410	.1429
ROTC	.2976	.1834	.1733	.0834	.1929	.1564	.1689	.1857
OCS	.4028	.5604	.6120	.7151	.6945	.7382	.5351	.5714
NESEP	.0200	.0987	.0951	.1486	.0262	.0655	.0550	.1000
WHITE	.9412	.9434	.9419	.9423	.9073	.8836	.9412	.9143
AFAM	.0344	.0345	.0342	.0278	.0772	.0945	.0455	.0571
OTHERS	.0244	.0221	.0238	.0299	.0155	.0218	.0133	.0286
GURL	.0260	.0284	N.I.	N.I.	.8421	.9491	N.I.	N.I.
SWO	.4030	.4210	N.I.	N.I.	.0807	.0291	N.I.	N.I.
SUB	.1679	.1682	N.I.	N.I.	N.I.	N.I.	N.I.	N.I.
PILOT	.2617	.2396	N.I.	N.I.	.0488	.0145	N.I.	N.I.
NFO	.1393	.1396	N.I.	N.I.	.0275	.0073	N.I.	N.I.
OTHERURL	.0020	.0033	N.I.	N.I.	.0009	.0000	N.I.	N.I.
RL	N.I.	N.I.	.2972	.3128	N.I.	N.I.	.4991	.4857
STAFF	N.I.	N.I.	.7028	.6872	N.I.	N.I.	.5009	.5143
FY85	.0228	.0587	.0457	.0708	.0385	.0573	.0591	.0303
FY86	.1095	.1044	.0391	.0388	.1162	.0573	.0315	.0606

Table V.1. Descriptive Statistics of Key Variables By Marital Status at Entry (cont).

Variable	URL Male		STF/RL Male		URL Female		STF/RL Female	
	Single at entry	Married at entry	Single at entry	Married at entry	Single at entry	Married at entry	Single at entry	Married at entry
FY87	.1145	.1096	.1401	.1125	.1079	.0510	.1142	.0606
FY88	.0897	.0695	.0836	.0708	.0604	.0573	.0906	.0303
FY89	.1184	.1041	.0686	.0592	.1691	.1146	.0748	.0303
FY90	.1019	.0982	.0920	.0844	.1208	.1274	.0866	.0909
FY91	.1058	.1341	.1203	.1242	.1125	.1274	.1417	.1515
FY92	.0033	.0029	.0583	.1106	.0008	.0000	.0236	.0909
FY93	.0859	.1135	.0872	.1222	.0989	.1465	.0945	.1212
FY94	.0910	.0976	.1028	.0912	.0770	.1338	.1181	.0909
FY95	.1571	.1073	.1624	.1154	.0981	.1274	.1654	.2424

Notes: [a]The numbers in parenthesis show the number of observations for each variable excluding those of missing values.

[b]PROMO, MARRIED2, and MILSPS2 are calculated among stayers to O4 promotion review. All other variables in the table are calculated among starters at entry.

N.I.= not included.

Tables V.2 – 4 show the results of two-sample t-tests for the difference in the performance proxies – PCTRAP12, PCTRAP3 and PROMO – between single and married groups at three points in time (O1, O3, and O4). Table V.2 shows that, except for STF/RL females, those who were married when entering the Navy received significantly higher 'accelerated promotion recommendations' scores during grades 1 and 2 compared to single entrants. For URL and STF/RL males, and URL females, officers who were married when entering the Navy received 6 – 8 percent more 'accelerated promotion recommendations' than those who were single.

Table V.2. Two-Sample t-test: Differences in PCTRAP12 Based on Marital Status at Entry by Community/Gender Group.

PCTRAP12	URL Male		STF/RL Male		URL Female		STF/RL Female	
	Single at entry	Married at entry	Single at entry	Married at entry	Single at entry	Married at entry	Single at entry	Married at entry
N (sample size)	18,492	5,013	2,906	1,364	2,081	262	486	66
Mean (%)	28.91	35.38	36.44	42.73	35.88	43.95	38.77	45.99
T-test[a]	-9.86 (<. 0001)		-5.11 (<. 0001)		-3.28 (.0011)		-1.49 (.1356)	

Notes: [a]T-test between 'Single' and 'Married' groups at entry time point. The values in parentheses are 'Pr > |t|' for one-tailed test

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Table V.3 examines the effect of marital status on performance during the six years served as an O3. It shows that male officers who were married at O3 received higher RAP scores The difference in PCTRAP3 between married and single male officers is smaller than the difference in PCTRAP12 Table IV.5, but it is still significant. URL male officers who were married received approximately 4 percent more RAP's, while STF/RL male officers received 6 percent more RAP's. However, there was no difference observed among females.

Table V.3. Two-Sample t-test: Differences in PCTRAP3 Based on Marital Status at O3.

PCTRAP3	URL Male		STF/RL Male		URL Female		STF/RL Female	
	Single at O3	Married at O3	Single at O3	Married at O3	Single at O3	Married at O3	Single at O3	Married at O3
N (sample size)	12,077	11,330	1,910	2,299	2,046	281	492	57
Mean (%)	60.73	64.34	65.52	71.02	66.82	65.52	69.89	69.62
T-test[a]	-7.87 (< .0001)		-5.38 (< .0001)		.61 (.5410)		.06 (.9526)	

Notes: [a]T-test between 'Single' and 'Married' groups at entry time point. The values in parentheses are 'Pr > |t|' for one-tailed test

Table V.4 shows how marital status at the O4 promotion review is related to the promotion outcome. A significant marriage premium in terms of the promotion rate is observed for URL and STF/RL males who were married at O4 promotion review, but not for females.

Table V.4. Two-Sample t-test: Differences in PROMO Based on Marital Status at O4.

PROMO	URL Male		STF/RL Male		URL Female		STF/RL Female	
	Single at O4	Married at O4	Single at O4	Married at O4	Single at O4	Married at O4	Single at O4	Married at O4
N (sample size)	2,396	9,991	511	2,189	1,070	413	200	87
Mean (ratio)	.6757	.7606	.6810	.7209	.7645	.7482	.7650	.7586
T-test[a]	-8.10 (< .0001)		-1.79 (.0728)		.66 (.5103)		.12 (.9074)	

Notes: [a]T-test between 'Single' and 'Married' groups at entry time point. The values in parentheses are 'Pr > |t|' for one-tailed test

In short, these t-tests show that marital status at O1 and at O3, as well as at O4, is significantly and positively related to the selected performance measures for both URL and STF/RL male officers. On the other hand, a marriage premium is not observed for female officers.

B. ACCUMULATED MARRIAGE YEARS

The variables in Table V.5 are based on marital status changes between either two or three different time points. The variables in the top panel of the table (SS_, SM_, MM_, and DW_) measure changes in marital status between O1 (in col. 1) and O3 (in col. 2). For example, the variable SM_ is coded as 1 for those who are single at entry and married at O3, and MM_ shows someone who is married throughout this period. DW_ is coded as 1 for those who are divorced or widowed throughout grades 1 and 2.

The variables in the second panel (_SS, _SM, _MM, and _DW) measure marital changes between O3 and O4. For example, the variable _SM is coded 1 for officers who are single at O3 and married at O4, whereas _MM reflects an officer who is married throughout the six years as an O3.

The variables in the third panel (SSS, SSM, SMM, MMM, DW) reflect all marital changes between O1 and O4. For example, the variable SMM is coded 1 for those who are single at entry, married at O3, and married at O4, while MMM reflects someone who is married throughout the 10-year period. Among other things, these variables allow us to measure accumulated years of marriage.

In the last column of Table V.5, 'accumulated years of marriage' is calculated using the following logic (see Figure V.1). Marriage status is observed at three time points: at entry (Point A), at the grade 3 promotion review (Point B), and at the grade 4 promotion review (Point C). The period from O1 to O3 usually covers 4 years, and the period from O3 to O4 covers 6 years. For the next step, marital status changes are assumed to occur at the mid-point of each time interval. Thus, if a person who is single at entry marries between entry (at the beginning of year1) and O3 (at the end of year 4), he is assumed to marry at the mid-point of the interval, the end of year 2 (or the beginning of year 3). Someone who marries between O3 (at the beginning of year 5) and O4 (at the end of year 10) is assumed to marry at the mid-point of years 7 and 8.

Table V.5. Description of Marital Status Change Variables and Accumulated Years of Marriage Years.

Variable Name	Marital Status as of:			Average Accumulated Years of Marriage
	O1	O3	O4	
Panel 1. Changes Between O1-O3				
SS_	Single	Single	N.I.	0
SM_	Single	Married		2
MM_	Married	Married		4
DW_	Div/Widow	Div/Widow		N.I.
Panel 2. Changes Between O3-O4				
_SS	N.I.	Single	Single	0
_SM		Single	Married	3
_MM		Married	Married	6
_DW		Div/Widow	Div/Widow	N.I.
Panel 3. Changes Between O1-O3 and O3-O4				
SSS	Single	Single	Single	0
SSM	Single	Single	Married	3
SMM	Single	Married	Married	8
MMM	Married	Married	Married	10
DW	Div/Widow	Div/Widow	Div/Widow	N.I.

Notes: N.I.= not included.

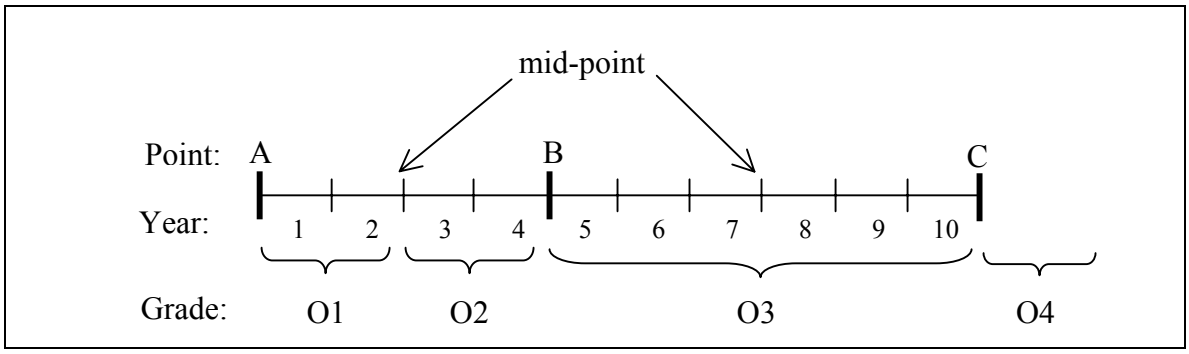

Figure V.1. Officer Career Path and Marriage Points.

Notes: A: Marital status at entry (MARRIED0).

B: Marital status at O3 (MARRIED1).

C: Marital status at O4 (MARRIED2).

Table V.6 shows the number of observations for each marital status change variable created in Table V.5. The figure in parenthesis is the column percentage for each panel.

Table V.6. Data on Marital Status Change Variables (Accumulated Years of Marriage).

Variable	URL Male	STF/RL Male	URL Female	STF/RL Female	Average Accumulated Years of Marriage
Panel 1. Changes Between O1-O3 (at the beginning of year 1 and year 5)					
SS_	13,374(.50)[a]	2,084(.44)	2,004(.79)	476(.80)	0
SM_	7,315(.28)	1,143(.24)	201(.08)	38(.06)	2
MM_	5,229(.20)	1,380(.29)	109(.04)	23(.04)	4
DW_	462(.02)	139(.03)	216(.09)	60(.10)	N.I.
Panel 2. Changes Between O3-O4 (at the beginning of year 5 and year 11)					
_SS	1,998(.16)	400(.15)	985(.66)	184(.63)	0
_SM	3,739(.30)	596(.22)	259(.17)	58(.20)	3
_MM	6,141(.49)	1,555(.57)	142(.10)	21(.07)	6
_DW	586(.05)	165(.06)	109(.07)	31(.10)	N.I.
Panel 3. Changes Between O1-O3 and O3-O4 (at the beginning of year 1, year 5, and year 11)					
SSS	1,974(.16)	392(.15)	928(.65)	175(.63)	0
SSM	3,643(.30)	566(.21)	237(.17)	52(.19)	3
SMM	3,350(.27)	626(.23)	84(.06)	10(.03)	8
MMM	2,776(.22)	924(.35)	58(.04)	11(.04)	10
DW	594(.05)	167(.06)	109(.08)	31(.11)	N.I.

Notes: [a]The numbers in parenthesis show the percentages of the column in each panel.

Descriptive statistics of the performance variables and correlation coefficients between performance and accumulated marriage years are calculated in Tables V.7 – 12 for 13 different groups. STF/RL female officers are excluded because of the small sample sizes. Thereafter, several groups are created based on the changes in marital status at different combinations of three time points. These tables present data separately for URL males, STF/RL males, and URL females.

Tables V.7 shows the three primary performance measures for URL males and for each marital status change between O1 and O4. The table shows that performance tends to rise with the length of marriage. This is reinforced in Table V.8, which shows that correlation coefficients between performance and years of marriage are positive and significant. For example, compared to single URL males with 0 marriage years (SS_), males with 4 marriage years (MM_) receive 7 percent more RAPs during grades 1 and 2 while males with two years of marriage (SM_) receive 2 percent more RAPs.

Table V.7. Performance Measures by Marital Change for URL Males.

Group	PCTRAP12[a]	PCTRAP3[a]	PROMO[a]	N (sample size)	Average Accumulated Years of Marriage
Panel 1. Changes Between O1-O3 (at the beginning of year 1 and year 5)					
SS_	28.30	N.I.	N.I.	11,729	0
SM_	30.02			6,619	2
MM_	35.75			4,740	4
DW_	28.37			413	N.I.
Panel 2. Changes Between O3-O4 (at the beginning of year 5 and year 11)					
_SS	N.I.	70.72	N.I.	1,924	0
_SM		74.42		3,676	3
_MM		74.34		5,988	6
_DW		68.24		538	N.I.
Panel 3. Changes Between O1-O3 and O3-O4 (at the beginning of year 1, year 5, and year 11)					
SSS	N.I.	N.I.	.6737	1,974	0
SSM			.7598	3,643	3
SMM			.7657	3,350	8
MMM			.7619	2,776	10
DW			.6820	500	N.I.

Notes: [a]Value in each cell is mean of the performance variable.
N.I.= not included.

Table V.8. Correlation Coefficients Between Performance Measures and Years of Marriage (or Divorce) for URL Males[a].

	PCTRAP12	PCTRAP3	PROMO
Accumulated Years of Marriage[b]	.0674*** (23,088)	.0376** (11,743)	.0547* (11,743)
Divorce Experience[c]	.0004 (12.142)	-.0340* (2,462)	.0071 (2,474)

Notes: [a]Each cell includes correlation coefficient and the number of observations in parenthesis.

[b]Accumulated Years of Marriage: is coded as 3 values (1: SS_, 2: SM_, 3: MM_) for PCTRAP12, 3 values (1: _SS, 2: _SM, 3: _MM) for PCTRAP3, and 4 values (1: SSS, 2: SSM, 3: SMM, 4: MMM) for PROMO.

[c]Divorce Experience: is coded as 2 values (1: SS_, 2: DW_) for PCTRAP12, 2 values (1: _SS, 2: _DW) for PCTRAP3, and 2 values (1: SSS, 2: DW) for PROMO.

*Indicates significance at .10 level; **at .05; ***at .01 level.

URL males who divorced or were widowed during grade 3 (_DW) are significantly and negatively correlated with RAP scores (PCTRAP3) when compared to single males. Divorced URL males receive 2 percent fewer RAP scores than those in _SS. However, URL males who divorced or were widowed either at O1 or O4 (DW_, DW) revealed no correlation with performance variables.

The results from Table V.9 show that for STF/RL males the performance proxies do not increase with the length of marriage. Only RAPs gained during grades 1 and 3 (PCTRAP12) increase with accumulated marriage time. RAPs gained during grade 3 (PCTRAP3) and the promotion probability (PROMO) decrease with the length of marriage. For example, compared to 2 years of marriage (SM_) males with 4 years of marriage (MM_) receive 7 percent more RAPs during grades 1 and 2. During grade 3, however, males married 3 years (_SM) receive 1 percent more RAPs than those married 6 years (_MM). The promotion probability (PROMO) for males married 10 years (MMM) is 5 percent lower than for males married 3 years (SSM).

Table V.9. Performance Measures by Marital Change for STF/RL Males.

Group	PCTRAP12[a]	PCTRAP3[a]	PROMO[a]	N (sample size)	Average Accumulated Years of Marriage
Panel 1. Changes Between O1-O3 (at the beginning of year 1 and year 5)					
SS_	36.67	N.I.	N.I.	1,829	0
SM_	36.04			1,035	2
MM_	43.25			1,277	4
DW_	35.98			130	N.I.
Panel 2. Changes Between O3-O4 (at the beginning of year 5 and year 11)					
_SS	N.I.	73.51	N.I.	389	0
_SM		79.24		588	3
_MM		78.02		1,518	6
_DW		75.24		156	N.I.
Panel 3. Changes Between O1-O3 and O3-O4 (at the beginning of year 1, year 5, and year 11)					
SSS	N.I.	N.I.	.6811	392	0
SSM			.7438	566	3
SMM			.7444	626	8
MMM			.6937	924	10
DW			.6644	149	N.I.

Notes: [a]Value in each cell is mean of the performance variable.

N.I.= not included.

Table V.10. Correlation Coefficients Between Performance Measures and Years of Marriage (or Divorce) for STF/RL Males[a].

	PCTRAP12	PCTRAP3	PROMO
Accumulated Years of Marriage[b]	.0706*** (4,141)	.0465** (2,495)	-.0074 (2,508)
Divorce Experience[c]	-.0046 (1,959)	.0285 (545)	-.0159 (541)

Notes: [a]Each cell includes correlation coefficient, and the number of observations in parenthesis.

[b]Accumulated Years of Marriage: is coded as 3 values (1: SS_, 2: SM_, 3: MM_) for PCTRAP12, 3 values (1: _SS, 2: _SM, 3: _MM) for PCTRAP3, and 4 values (1: SSS, 2: SSM, 3: SMM, 4: MMM) for PROMO.

[c]Divorce Experience: is coded as 2 values (1: SS_, 2: DW_) for PCTRAP12, 2 values (1: _SS, 2: _DW) for PCTRAP3, and 2 values (1: SSS, 2: DW) for PROMO.

*Indicates significance at .10 level; **at .05; ***at .01 level.

However, Table V.10 shows a significant and positive correlation between time married and PCTRAP12 and PCTRAP3. With respect to divorce, STF/RL males who divorced or widowed either at O1, O3, or O4 (DW_, _DW, and DW) show no significant correlation with fitness report scores or promotion outcomes when compared to single males.

Tables V.11 – 12 show the same relationships for URL females. Fitness report scores during grades 1 and 2 (PCTRAP12) are significantly and positively correlated with accumulated years of marriage, even though officers married 2 years (SM_) receive 3 percent lower RAP scores when compared to singles (SS_). In contrast, RAP scores during grade 3 (PCTRAP3) and promotion probabilities (PROMO) are not significantly correlated with 'accumulated marriage years.' URL females who divorced or widowed either at O1 or at O3 or O4 (DW_, _DW, and DW) also are not correlated with fitness reports or promotion when compared to single males.

In summary, the relationship between performance proxies and accumulated marriage years differ among the three groups. For URL males, all three performance proxies are significantly and positively correlated with years married. STF/RL males' RAP scores during grades 1, 2, and 3 (PCTRAP12 and PCTRAP3) are significantly and positively related to accumulated marriage years, but promotion probability is not correlated with years of marriage. For URL females, RAP scores during grades 1 and 2 (PCTRAP12 only) have a significant and positive correlation, but PCTRAP3 and PROMO are not correlated with years of marriage. As regards divorce, in all cases, except for the case of PCTRAP3 in URL males, there is no correlation between performance proxies and divorce status.

Table V.11. Performance Measures by Marital Change for URL Females.

Group	PCTRAP12[a]	PCTRAP3[a]	PROMO[a]	N (sample size)	Average Accumulated Years of Marriage
Panel 1. Changes Between O1-O3 (at the beginning of year 1 and year 5)					
SS_	36.29	N.I.	N.I.	1,857	0
SM_	33.18			175	2
MM_	45.91			106	4
DW_	39.61			205	N.I.
Panel 2. Changes Between O3-O4 (at the beginning of year 5 and year 11)					
_SS	N.I.	71.74	N.I.	966	0
_SM		77.58		259	3
_MM		72.04		139	6
_DW		72.15		104	N.I.
Panel 3. Changes Between O1-O3 and O3-O4 (at the beginning of year 1, year 5, and year 11)					
SSS	N.I.	N.I.	.7640	928	0
SSM			.7426	237	3
SMM			.6905	84	8
MMM			.8276	58	10
DW			.7423	97	N.I.

Notes: [a]Value in each cell is mean of the performance variable.

N.I.= not included.

Table V.12. Correlation Coefficients Between Performance Measures and Years of Marriage (or Divorce) for URL Females[a].

.	PCTRAP12	PCTRAP3	PROMO
Accumulated Years of Marriage[b]	.0354** (2,138)	.0378 (1,364)	-.0067 (1,307)
Divorce Experience[c]	.0263 (2,062)	.0041 (1,070)	-.0149 (1,025)

Notes: [a]Each cell includes correlation coefficient, and the number of observations in parenthesis.

[b]Accumulated Years of Marriage: is coded as 3 values (1: SS_, 2: SM_, 3: MM_) for PCTRAP12, 3 values (1: _SS, 2: _SM, 3: _MM) for PCTRAP3, and 4 values (1: SSS, 2: SSM, 3: SMM, 4: MMM) for PROMO.

[c]Divorce Experience: is coded as 2 values (1: SS_, 2: DW_) for PCTRAP12, 2 values (1: _SS, 2: _DW) for PCTRAP3, and 2 values (1: SSS, 2: DW) for PROMO.

*Indicates significance at .10 level; **at .05; ***at .01 level.

C. SELECTION INTO MARRIAGE

For officers who were single during grades 1 and 2, two groups were created: one group that will marry when they reach grade 3 (SSM) and a second group that will not marry (SSS). By comparing these two groups' average performances on their fitness reports, the goal was to determine whether officers who will marry in the future receive higher performance scores when they were single compared to single officers who will remain single in the future.

In Table V.13, values of PCTRAP12 during grades 1 and 2 were compared between SSS and SSM officers to identify differences in current outcomes for those to be married in the future. Officers in both groups were single for the period during grades 1 and 2 from which PCTRAP12 is drawn, but during grade 3 officers in SSM were married while those in SSS remained single. Therefore, the differential in PCTRAP12 may indicate some unobserved characteristics between the two groups that may cause potentially more successful officers to marry in higher percentages.

Table V.13. Two-Sample t-test: Selection into Marriage Analysis[a].

	URL Male		STF/RL Male		URL Female	
	SSS	SSM	SSS	SSM	SSS	SSM
N	1,962	3,641	403	579	960	246
PCTRAP12 (%)	29.63	33.16	39.71	42.67	36.61	33.46
T-test[b]	-3.14 (.0017)		-1.22 (.2228)		1.21 (.2215)	

Notes: [a]Sample consists of stayers to O4 promotion review.

[b]T-test between 'not to be married' and 'to be married' groups at entry time point. The values in parentheses are 'Pr > |t|' for one-tailed test.

The results show that for URL males, the to-be-married (SSM) group has approximately 4 percent more PCTRAP12 scores than the SSS group, which is a significant difference (t-test = -3.14). For STF/RL males, the difference is approximately 3 percent higher for the to-be-marrieds, but it is not significant. The difference is 3 percent smaller for SSM of URL females, just the opposite of the male groups, but this result is not significant. The only significant results for URL males suggest that some

amount of the marriage premium may be due to unobservable characteristics of officers that are correlated with both more successful performers and selection into marriage.

D. NUMBER OF DEPENDENTS

The variables in Table V.14 show the coding of dependents at three time points.

Table V.14. Description of Dependents Variables (Number of Dependents).

Variable Name	Variable Description
NONDEP0/1/2	Number of dependents at entry/O3/O4 (1: single with no child, 0: others)
SPSONLY0/1/2	Number of dependents at entry/O3/O4 (1: spouse only, 0: others)
SPS_1CH0/1/2	Number of dependents at entry/O3/O4 (1: spouse + 1 child, 0: others)
SPS_2CH0/1/2	Number of dependents at entry/O3/O4 (1: spouse + 2 children, 0: others)
SPS_3CH0/1/2	Number of dependents at entry/O3/O4 (1: spouse + 3 or more children, 0: others)
DIVCH0/1/2	Number of dependents at entry/O3/O4 (1: divorced with children, 0: others)

Table V.15 depicts the descriptive statistics of the dependents variables separately for URL and STF/RL males and URL females. STF/RL males have more dependents than URL males over time, which is reinforced by the fact that STF/RL males are more likely to be married at O1 and at O3.

Table V.15. Descriptive Statistics of Dependents Variables (Number of Dependents) By Community and Gender.

Variable	URL Male	STF/RL Male	URL Female
NONDEP0/1/2	.79[a]/ .52[b]/ .17[c]	.69/ .45/ .16	.94/ .85/ .69
SPSONLY0/1/2	.15/ .32/ .24	.17/ .28/ .19	.04/ .09/ .13
SPS_1CH0/1/2	.03/ .09/ .21	.07/ .11/ .20	.01/ .03/ .07
SPS_2CH0/1/2	.02/ .05/ .25	.05/ .10/ .28	.01/ .01/ .06
SPS_3CH0/1/2	.01/ .01/ .11	.02/ .04/ .14	.00/ .00/ .01
DIVCH0/1/2	.00/ .01/ .02	.00/ .02/ .03	.00/ .02/ .04

Note: [a]The first figure is the percentages of the column based on dependents at entry.

[b]The second figure is the percentages of the column based on dependents at O3.

[c]The third figure is the percentages of the column based on dependents at O4.

At entry, STF/RL males are less likely to be single and more likely to have dependents when compared to URL males. At O3, STF/RL males are still less likely to be single and to have 'spouse only' as dependent but they are more likely to have 'spouse + child(ren).' Also, at O4, STF/RL males are less likely to be single and to have 'spouse only' and 'spouse + child' but they are still more likely to have 'spouse + children.'

Tables V.16 – 21 examine the effect of 'number of dependents' and make three comparisons: (1) a comparison of PCTRAP12 by dependents at O1, which differs in the number of dependents for the period of grades 1 and 2; (2) a comparison of PCTRAP3 by dependents for the period of grade 3; (3) and a comparison of PROMO by dependents for the entire period from entry to O4.

Table V.16. URL Male Officers: Descriptive Statistics of Performance Proxies and Number of Dependents.

Group	PCTRAP12[a]	PCTRAP3[a]	PROMO[a]	N (sample size)	Number of Dependents
Panel 1. Dependents at entry (at the beginning of year 1)					
NONDEP0	28.93	N.I.	N.I.	18,365	0
SPSONLY0	34.73			3,466	1
SPS_1CH0	35.18			776	2
SPS_2CH0	38.20			526	3
SPS_3CH0	40.14			164	≥ 4
Panel 2. Dependents at O3 (at the beginning of year 5)					
NONDEP1	N.I.	60.71	N.I.	11,881	0
SPSONLY1		64.10		7,617	1
SPS_1CH1		64.32		2,153	2
SPS_2CH1		64.68		1,184	3
SPS_3CH1		68.08		376	≥ 4
Panel 3. Dependents at O4 (at the beginning of year 11)					
NONDEP2	N.I.	N.I.	.6742	2,155	0
SPSONLY2			.7602	2,978	1
SPS_1CH2			.7768	2,576	2
SPS_2CH2			.7678	3,105	3
SPS_3CH2			.7132	1,332	≥ 4

Notes: [a]Value in each cell is mean of the performance proxies.
N.I.= not included.

Table V.17. URL Male Officer: Correlation Coefficient of Performance Proxies with Number of Dependents[a].

	PCTRAP12	PCTRAP3	PROMO
Number of Dependents[b]	.0631*** (23,297)	.0477*** (23,211)	.0364*** (12,146)

Notes: [a]Each cell includes correlation coefficient, and the number of observations in parenthesis.

[b]Number of Dependents: is coded as 5 values (0: NONDEP, 1: SPSONLY, 2: SPS_1CH, 3: SPS_2CH, 4: SPS_3CH) at entry, O3, and O4 for PCTRAP12, PCTRAP3, and PROMO, respectively.

*Indicates significance at .10 level; **at .05; ***at .01 level.

As shown in Tables V.16 – 17, for URL males, 'the number of dependents' is significantly and positively correlated with 'early promotion recommendations' (PCTRAP12 and PCTRAP3). Also, URL males with dependents (spouse only or spouse + children) are more likely to be promoted to grade 4 compared to those without dependents, but the increased number of dependents does not consistently increase the promotion probability.

Tables V.18 – 19 show results for STF/RL males. RAP scores during grades 1/2 and 3 (PCTRAP12, PCTRAP3) are significantly and positively correlated with the number of dependents, but promotion (PROMO) is not correlated. Even though STF/RL males with dependents (spouse only or spouse + children) are more likely to be promoted to grade 4 compared to those without dependents, the increased number of dependents does not consistently increase 'early promotion recommendations' or the promotion probability.

Table V.18. STF/RL Male Officers: Descriptive Statistics of Performance Proxies and Number of Dependents.

Group	PCTRAP12[a]	PCTRAP3[a]	PROMO[a]	N (sample size)	Number of Dependents
Panel 1. Dependents at entry (at the beginning of year 1)					
NONDEP0	36.26	N.I.	N.I.	2,857	0
SPSONLY0	43.66			715	1
SPS_1CH0	37.86			294	2
SPS_2CH0	44.94			253	3
SPS_3MCH0	47.74			79	≥ 4
Panel 2. Dependents at O3 (at the beginning of year 5)					
NONDEP1	N.I.	65.20	N.I.	1,843	0
SPSONLY1		68.95		1,208	1
SPS_1CH1		73.59		500	2
SPS_2CH1		71.63		437	3
SPS_3H1		77.23		154	≥ 4
Panel 3. Dependents at O4 (at the beginning of year 11)					
NONDEP2	N.I.	N.I.	.6848	441	0
SPSONLY2			.7553	523	1
SPS_1CH2			.7081	531	2
SPS_2CH2			.7241	743	3
SPS_3CH2			.6862	392	≥ 4

Notes: [a]Value in each cell is mean of the performance proxies.

N.I.= not included.

Table V.19. STF/RL Male Officer: Correlation Coefficient of Performance Proxies with Number of Dependents[a].

	PCTRAP12	PCTRAP3	PROMO
Number of Dependents[b]	.0732*** (4,198)	.0981*** (4,142)	-.0065 (2,630)

Notes: [a]Each cell includes correlation coefficient, and the number of observations in parenthesis.

[b]Number of Dependents: is coded as 5 values (0: NONDEP, 1: SPSONLY, 2: SPS_1CH, 3: SPS_2CH, 4: SPS_3CH) at entry, O3, and O4 for PCTRAP12, PCTRAP3, and PROMO, respectively.

*Indicates significance at .10 level; **at .05; ***at .01 level.

Tables V.20 – 21 present results for URL females. It is difficult to generalize the relationship between PCTRAP12 and the number of dependents due to small sample sizes in some groups. However, correlation coefficients show that RAP scores during grades 1 and 2 are significantly and positively correlated with the number of dependents. In other words, URL females with dependents (spouse only or spouse + children) are more likely to receive RAPs for the four-year period of grades 1 and 2 (PCTRAP12). In contrast to PCTRAP12, there is no significant correlation between the number of dependents and 'early promotion recommendations' for the grade 3 period (PCTRAP3) or promotion.

Table V.20. URL Female Officers: Descriptive Statistics of Performance Proxies and Number of Dependents.

Group	PCTRAP12[a]	PCTRAP3[a]	PROMO[a]	N (sample size)	Number of Dependents
Panel 1. Dependents at entry (at the beginning of year 1)					
NONDEP0	36.04	N.I.	N.I.	2,037	0
SPSONLY0	45.34			98	1
SPS_1CH0	51.11			21	2
SPS_2CH0	50.63			8	3
SPS_3CH0	0			1	≥ 4
Panel 2. Dependents at O3 (at the beginning of year 5)					
NONDEP1	N.I.	66.75	N.I.	1,990	0
SPSONLY1		63.08		198	1
SPS_1CH1		75.47		61	2
SPS_2CH1		60.93		20	3
SPS_3CH1		50.55		2	≥ 4
Panel 3. Dependents at O4 (at the beginning of year 11)					
NONDEP2	N.I.	N.I.	.7704	1,015	0
SPSONLY2			.7641	195	1
SPS_1CH2			.7593	108	2
SPS_2CH2			.7222	90	3
SPS_3CH2			.6500	20	≥ 4

Notes: [a]Value in each cell is mean of the performance proxies.

N.I.= not included.

Table V.21. URL Female Officer: Correlation Coefficient of Performance Proxies with Number of Dependents[a].

	PCTRAP12	PCTRAP3	PROMO
Number of Dependents[b]	.0589*** (2,165)	-.0023 (2,271)	-.0363 (1,428)

Notes: [a]Each cell includes correlation coefficient, and the number of observations in parenthesis.

[b]Number of Dependents: is coded as 5 values (0: NONDEP, 1: SPSONLY, 2: SPS_1CH, 3: SPS_2CH, 4: SPS_3CH) at entry, O3, and O4 for PCTRAP12, PCTRAP3, and PROMO, respectively.

*Indicates significance at .10 level; **at .05; ***at .01 level.

In short, like the results in the relationship between performance proxies and accumulated marriage years, a greater number of dependents is not consistently correlated with performance. That is, for URL males, all three proxies are significantly and positively correlated with an increasing number of dependents, whereas for STF/RL males, PCTRAP12 and PCTRAP3 are positively correlated, and for URL females only PCTRAP12 is positively correlated with dependents.

E. HUMAN CAPITAL INVESTMENT

Tables V.22 – 23 present how accumulated years of marriage affect officers' human capital investment in graduate school education. For URL and STF/RL males, years of marriage are positively correlated with graduate degrees. Compared to singles (SSS), males who have been married for 3 years (SSMs) are 5 – 7 percent more likely to have a graduate degree, while those with 8 years of marriage (SMM) are 7 – 9 percent more likely to have a graduate degree. However, marriage years during grade 1 do not seem to influence graduate degrees among males.

Table V.22. Graduate Degrees (in percent) by Marital Change and Officer Group.

Group	URL Males		STF/RL Males		URL Females		Average Accumulated Years of Marriage
	N (sample size)	Ratio	N	Ratio	N	Ratio	
SSS	1,974	.1976	392	.2372	928	.3511	0
SSM	3,643	.2435	566	.3004	237	.3629	3
SMM	3,350	.2651	626	.3227	84	.3571	8
MMM	2,776	.2662	924	.3258	58	.4483	10
DW	594	.1768	167	.2395	109	.3028	N.I.

Notes: N.I.= not included.

Table V.23. Correlation Coefficient of Graduate Degree (GRADSCH) and Accumulated Years of Marriage (or Divorce Experience) by Officer Group[a].

	URL Males	STF/RL Males	URL Females
Accumulated Years of Marriage[b]	.0506*** (11,743)	.0596*** (2,508)	.0261 (1,307)
Divorce Experience[c]	-.0222 (2,568)	.0025 (559)	-.0367 (1,037)

Notes: [a]Each cell includes correlation coefficient, and the number of observations in parenthesis.

[b]Accumulated Years of Marriage: is coded as 4 values (1: SSS, 2: SSM, 3: SMM, 4: MMM).

[c]Divorce Experience: is coded as 2 values (1: SSS, 2: DW).

*Indicates significance at .10 level; **at .05; ***at .01 level.

In contrast to males, URL females' graduate school education does not differ much among groups with 0, 3, and 8 years of marriage (SSS, SSM, SMM). However, marriage years during grade 1 seem to have a strong effect on female graduate school education: MMM females are 11 percent more likely to have a graduate school education than SSS. URL males and females divorced or widowed either at O1, or at O3, or at O4 are 2 – 5 percent less likely to have graduate education than SSS but these results are not significant.

F. NONRANDOM SAMPLE SELECTION

From Table V.3, approximately 50 percent of officers leave the Navy during their first 10 years between entry and O4 promotion review. Almost all attrition occurs during grade 3. In general, leavers can be categorized into two types. One type is leavers who are poor performers and have a promotion probability that is below average. On the other hand, leavers are officers of above average skills who think they will be better off in the civilian sector. If the Navy data have one of these characteristics for leavers, then models of two performance proxies (PCTRAP3 and PROMO) will obtain biased estimators. In other words, if attrition of the Navy officers is systematically correlated with unobservables, it may bias estimators of performance measures due to nonrandom sample selection.

Tables V.24 – 25 presents whether retention differs between 'not married' and 'married,' and whether promotion rates differ between starters and stayers. The data are

divided into four groups based on officer community and gender. Thereafter, the four groups are divided again into two sub groups based on marriage experience. The 'not married' group contains all officers who are not married at either grades 1 – 2 or grade 3 while the 'married' group contains all officers who are married either at grades 1 – 2 or grade 3. The number of stayers, leavers, and promotees, and the retention and promotion rates, are calculated for each group.

Table V.24. Two-Sample t-test: Differences in Retention based on Marriage Experience.

	URL Male		STF/RL Male		URL Female		STF/RL Female	
	Not Married[a]	Married[b]	Not Married	Married	Not Married	Married	Not Married	Married
Starters[c]	13,374	13,005	2,084	2,661	2,004	526	476	121
Stayers[d]	5,667	6,684	968	1,726	1,184	298	223	54
Leavers[e]	7,707	6,321	1,116	935	820	228	243	67
RR[f]	.4237	.5140	.4645	.6486	.5908	.5665	.4895	.4463
T-test[g]	-14.74 (< .0001)		-12.86 (<. 0001)		1.01 (.3146)		.85 (.3964)	

Notes: [a]Not Married: Those who are single at O-1 and O-3 as well.

[b]Married: Those who are married either at O-1 or /and O-3.

[c]Starters: Sample size of officers who entered the Navy.

[d]Stayers: Number of officers who stayed the Navy at O4 promotion review.

[e]Leavers: Number of officers who left the Navy between entry and O4 promotion review.

[f]Retention rate = Stayers/Starters.

[g]T-test between 'Single' and 'Married' groups at entry time point. The values in parentheses are 'Pr > $|t|$' for one-tailed test

The t-tests show that the retention rate is 9 and 19 percent higher for married male URL and STF/RL officers, respectively. For married URL females, retention is 2 percent lower but not significant.

Table V.25. Promotion Rate based on Marriage Experience.

	URL Male		STF/RL Male		URL Female		STF/RL Female	
	Not Married[a]	Married[b]	Not Married	Married	Not Married	Married	Not Married	Married
Starters[c]	13,374	13,005	2,084	2,661	2,004	526	476	121
Stayers[d]	5,667	6,684	968	1,726	1,184	298	223	54
Promotees[e]	4,129	5,063	695	1,227	893	233	180	39
PR1[f]	.3087	.3893	.3385	.4611	.4456	.4430	.3782	.3223
PR2[g]	.7286	.7575	.7180	.7109	.7542	.7819	.7725	.7222

Notes: [a]Not Married: Those who are single at O-1 and O-3 as well.

[b]Married: Those who are married either at O-1 or /and O-3.

[c]Starters: Sample size of officers who entered the Navy.

[d]Stayers: Number of officers who stayed the Navy at O4 promotion review.

[e]Number of promotees to the grade 4.

[f]Promotion rate 1 = Promotees/Starters.

[g]Promotion rate 2 = Promotees/Stayers.

In Table V.25, promotion rate 1 (PR1 = Promotees/Starters) is 8 and 12 percent higher for male married URL and STF/RL officers, respectively. However, promotion rate 2 (PR2 = Promotees/Stayers) is only 3 percent higher for married URL males and there is no difference between single and married STF/RL male officers. In other words, when the promotion rate is calculated based on the officers who stayed until the promotion review, the apparent marriage premium almost disappears for males. For URL females, there seems little difference in promotion rates between 'married' and 'not married' officers.

Since males have a significantly different retention behavior between 'not married' and 'married' officers and that a large portion of the promotion rate differential disappears when promotees are divided by stayers, the thesis will use a 'two-stage model' to control for nonrandom sample selection.

VI. RESULTS

In the first part of this chapter, we analyze the marriage premium using basic single stage regression models. We analyze the first two performance models (PCTRAP12 and PCTRAP3) using Ordinary Least Squares (OLS) regression techniques, and analyze the promotion model using maximum likelihood probit models. By using Naval officer data, we test five main arguments about the marriage premium and dependent status discussed in the literature review chapter:

1. Marriage Premium Based on 'Married' and 'Single': Analyzing the direct effect of marriage on the productivity of officers. The 'Married' and 'Single' groups are officers who are married or single during the period the performance proxy covers.

2. Accumulated Years of Marriage: Estimating the effect of years of marriage on performance. If performance increases with accumulated years of marriage, it implies a positive effect of marriage on productivity.

3. Selection into Marriage: Estimating the performance of two officer groups while they were single. One group will marry in the future, and the other group will remain single. If the first group performs better, we can conclude that the apparent higher performance of married officers may be overstated due to unobservable characteristics of the officers.

4. Number of Dependents: Estimating the effects of dependents on the performance of officers.

5. Human Capital Investment: Measuring the relationship between marital status and graduate school completion. Higher investment in human capital signals greater productivity.

In the second part of the chapter, we use 'two-stage' models to correct for potential biases caused by officers who leave the Navy prior to the O4 promotion review. Since two of our basic models (PCTRAP3 and PROMO) are based on officers who remain in the Navy, these models do not include the effects of officers who leave the Navy earlier, which may bias the marriage premium coefficients.

A. BASIC MODEL RESULTS

1. Marriage Premium Based on 'Married' and 'Single'

For the three different performance variables, we estimate the marriage premium in three successive regression models for each of the three officer groups. In the first

model we control for commissioning background, ethnicity, age and prior enlisted service experience. In the second model, we add college grade point average (GPA), and in the third model we add major officer sub-specialties (communities) as control variables. For the promotion outcome model we add dummy variables for the fiscal years of the promotion boards to control for varying promotion opportunities over time. The promotion outcome is not only a function of an officer's productivity, but it is also affected by the available positions in the next higher grade in the year an officer is evaluated for the promotion. Thus, omitting the fiscal year dummies would cause bias in estimates. Table VI.1 shows the coefficients and marginal effects of the marital status variables for URL males.

As we add more control variables in the rating performance (PCTRAP12 and PCTRAP3) models for URL males, the coefficients of marital status change only slightly. The results of the third model, which includes all control variables, show that URL officers who were married when they entered the Navy received 23.6 percent more RAP's during grades 1 and 2 than officers who were single at entry. During grade 3, officers who were married at the beginning of grade 3 received 5.7 percent more RAP's during grade 3 than officers who were single at the beginning of the grade 3 period. At the O4 promotion review officers who were married at that time were 8.7 percentage points more likely to be promoted.

In all models, college grade point average (GPA), graduate school education (GRADSCH) and prior enlisted experience (PRIOR) are significantly and positively correlated with the performance variables. Age and ethnicity other than white are negatively correlated with performance. Interestingly, most of the commissioning source variables compared to OCS have a significant and positive effect on performance, whereas some of the community variables do not have a significant effect.

Anderson and Krieg (2000) find similar relationships between marriage and performance of U.S. Marine Corps enlisted personnel. They find that married Marines receive higher performance evaluation scores than single Marines. They also find that married Marines have a higher promotion probability than single Marines.

Table VI.1. Performance Models for URL Males[a].

Variable	PCTRAP12			PCTRAP3			PROMO[b]		
MARRIED0	6.609*** (.680)	7.156*** (.736)	7.148*** (.719)	--	--	--	--	--	--
MARRIED1	--	--	--	3.623*** (.467)	3.527*** (.498)	3.650*** (.496)	--	--	--
MARRIED2	--	--	--	--	--	--	.286*** (.031) [.096]	.263*** (.032) [.087]	.265*** (.032) [.087]
GURL	--	--	-17.71*** (2.210)	--	--	-16.38*** (2.074)	--	--	-.803*** (.125)
SUB	--	--	4.214*** (.873)	--	--	5.677*** (.761)	--	--	-.021 (.044)
PILOT	--	--	-18.30*** (.712)	--	--	-4.646*** (.625)	--	--	-.106*** (.034)
NFO	--	--	-13.34*** (.835)	--	--	1.793*** (.726)	--	--	-.139*** (.036)
GPA	--	4.655*** (.299)	3.088*** (.307)	--	3.420*** (.257)	2.672*** (.269)	--	.141*** (.014)	.143*** (.015)
GRADSCH	--	--	--	--	13.02*** (.696)	12.61*** (.699)	--	.262*** (.032)	.245*** (.033)
USNA	1.187 (.743)	2.012** (.808)	-.707 (.794)	9.079*** (.646)	8.479*** (.693)	7.497*** (.694)	-.017 (.037)	-.005 (.039)	-.027 (.039)
ROTC	.436 (.729)	.511 (.817)	-2.223*** (.804)	3.615*** (.635)	2.772*** (.700)	2.238*** (.702)	-.220*** (.036)	-.199*** (.038)	-.215*** (.039)
NESEP	6.515*** (1.588)	1.494 (1.826)	.824 (1.784)	3.992*** (1.354)	1.011 (1.558)	.912 (1.550)	.055 (.062)	-026 (.066)	.050 (.066)
AFAM	-8.217*** (1.460)	-4.736*** (1.564)	-7.650*** (1.534)	-8.96*** (1.282)	-6.312*** (1.351)	-6.283*** (1.349)	-.353*** (.062)	-.242*** (.065)	-.252*** (.066)
OTHERS	-3.509** (1.716)	-2.037 (1.905)	-4.646** (1.864)	-2.573* (1.505)	-1.764 (1.637)	-1.965 (1.631)	-.267*** (.081)	-.199** (.084)	-.201** (.084)
AGE	-1.131*** (.160)	-.673*** (.179)	-.877*** (.176)	-.724*** (.139)	-0.488*** (.153)	-.430*** (.154)	-.072*** (.008)	-.067*** (.008)	-.070*** (.008)
PRIOR	8.202*** (1.135)	6.799*** (1.255)	3.680*** (1.229)	7.394*** (.984)	5.431*** (1.075)	4.349*** (1.073)	.023 (.051)	-.033 (.054)	-.053 (.054)
Intercept	53.949	29.568	47.179	73.602	57.445	59.073	2.301	1.770	1.933
N	23,464	19,629	19,629	23,363	19,583	19,583	12,351	11,640	11,640
R^2	.0114	.0226	.0696	.0207	.0480	.0596	N.A.	N.A.	N.A.
-2 LOG L	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	13,692.10	12,648.91	12,592.97
Dep. Mean	30.30	30.19	30.19	62.47	63.16	63.16	.7332	.7462	.7462

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

N.A.= not applicable.

The methodology we use in this thesis is similar to the methodology of Hill (1979). In her model Hill uses OLS techniques and controls for numerous individual characteristics in successive regressions. She reports that as she includes more controls in her model, the marriage premium stays stable. She controls for variables such as job tenure, firm specific training, occupation, industry, and work experience which are controlled automatically in our officer data set. She finds that married men earn 25-30 percent more than single men.

For URL male officers, the promotion probability difference between married and single officers is similar to the promotion probability difference between married and single workers in the firm studied by Korenman and Neumark (1991). In our probit model the promotion probability for URL officers is 8.7 percentage points higher than for single officers, whereas in the KN study the promotion advantage for married workers is 10.5 percentage points.

The model results (coefficients and marginal effects) for STF males are shown in Table VI.2. Similar to URL male officers, STF male officers receive positive and significant marriage premiums for all three performance indicators. However, the marriage premiums for STF/RL males tend to be smaller than those observed for URL males. The results show that STF officers who entered the Navy married received 15.5 percent more RAP's during grades 1 and 2 than officers who were single at entry. Officers who were married at the beginning of grade 3 received 4.2 percent more RAP's than officers who started grade 3 as single. At the promotion review, officers who were married, were promoted at a 6.0 percent higher rate than officers who were single.

Similar to the results for URL males, college grade point average (GPA) and graduate school education (GRADSCH) are significantly and positively correlated with the performance variables. However, the effect of prior enlisted experience (PRIOR) in the STF male models is not significant. Ethnicity is negatively correlated with the performance variables in the models.

Table VI.3 shows the performance model results for URL females. For URL females, a marriage premium is observed only for the PCTRAP12 performance variable. It shows that URL female officers who were married at entry received 15.4 percent more

RAP's during grades 1 and 2 than female officers who were single at entry. Neither PCTRAP3 nor promotion were significantly affected by marital status.

Table VI.2. Performance Models for STF/RL Males[a].

Variable	PCTRAP12			PCTRAP3			PROMO[b]		
MARRIED0	5.298*** (1.351)	5.742*** (1.439)	5.877*** (1.429)	--	--	--	--	--	--
MARRIED1	--	--	--	4.450*** (1.061)	2.918*** (1.114)	2.938*** (1.114)	--	--	--
MARRIED2	--	--	--	--	--	--	.156** (.066) [.054]	.155** (.068) [.053]	.174** (.068) [.060]
RL	--	--	9.417*** (1.322)	--	--	1.791 (1.141)	--	--	.198*** (.062)
GPA	--	5.232*** (.704)	4.999*** (.700)	--	2.035*** (.606)	1.992*** (.606)	--	.110*** (.031)	.108*** (.031)
GRADSCH	--	--	--	--	10.63*** (1.327)	10.57*** (1.328)	--	.336*** (.065)	.334*** (.065)
USNA	8.475*** (2.097)	11.450*** (2.246)	10.744*** (2.233)	6.675*** (1.834)	7.304*** (1.924)	7.180*** (1.925)	.430*** (.112)	.497*** (.117)	.477*** (.118)
ROTC	-5.162*** (1.865)	-5.431*** (1.970)	-4.215** (1.964)	-6.93*** (1.632)	-7.083*** (1.685)	-6.83*** (1.692)	-.035 (.089)	-.073 (.091)	-.055 (.092)
NESEP	-9.440*** (1.865)	-10.57*** (2.050)	-9.05*** (2.047)	-6.83*** (1.644)	-9.698*** (1.816)	-9.38*** (1.827)	.116 (.080)	-.019 (.087)	.009 (.088)
AFAM	-15.01*** (3.202)	-13.75*** (3.511)	-12.81*** (3.490)	-6.863** (2.786)	-6.868** (2.987)	-6.683** (2.989)	-.104 (.150)	-.120 (.156)	-.099 (.156)
OTHERS	-11.50*** (3.516)	-7.934** (3.921)	-6.723* (3.898)	-8.98*** (3.083)	-5.187 (3.368)	-4.960 (3.371)	.095 (.166)	.139 (.178)	.155 (.178)
AGE	.570** (.279)	.796*** (.302)	.794*** (.300)	.463* (.240)	.425* (.255)	.426* (.255)	-.024** (.012)	-.020 (.013)	-.023* (.013)
PRIOR	.324 (1.879)	-.387 (1.994)	-1.243 (1.984)	2.174 (1.643)	2.822* (1.710)	2.663 (1.713)	-.081 (.079)	-.058 (.082)	-.066 (.082)
Intercept	24.410	1.598	-.761	55.744	49.148	48.667	1.210	.715	.616
N	4,270	3,663	3,663	4,209	3,629	3,629	2,700	2,561	2,561
R^2	.0282	.0469	.0599	.0281	.0490	.0497	N.A.	N.A.	N.A.
-2 LOG L	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	3,172.22	2,959.29	2,949.08
Dep. Mean	38.45	37.84	37.84	68.53	68.88	68.88	.7133	.7130	.7130

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

N.A.= not applicable.

Table VI.3. Performance Models for URL Females[a].

Variable	PCTRAP12			PCTRAP3			PROMO[b]		
MARRIED0	7.210*** (2.491)	5.649** (2.683)	5.433** (2.678)	--	--	--	--	--	--
MARRIED1	--	--	--	-.933 (2.219)	-1.442 (2.208)	-1.321 (2.211)	--	--	--
MARRIED2	--	--	--	--	--	--	-.011 (.082) [-.003]	.004 (.085) [.001]	.031 (.086) [.009]
SWO	--	--	7.428** (3.163)	--	--	4.000 (2.734)	--	--	.892*** (.198)
PILOT	--	--	-8.706** (4.127)	--	--	-2.612 (3.604)	--	--	.317 (.233)
NFO	--	--	-19.66*** (5.258)	--	--	-.054 (4.561)	--	--	.798** (.310)
GPA	--	3.466*** (.920)	3.433*** (.917)	--	1.782** (.800)	1.738** (.801)	--	.132*** (.043)	.116*** (.044)
GRADSCH	--	--	--	--	15.17*** (1.620)	15.01*** (1.625)	--	.445*** (.082)	.461*** (.084)
USNA	12.72*** (3.023)	18.45*** (3.216)	20.12*** (3.287)	17.18*** (2.679)	20.34*** (2.782)	20.11*** (2.860)	.337* (.173)	.364** (.181)	.194 (.189)
ROTC	7.843*** (2.216)	9.115*** (2.468)	9.547*** (2.484)	8.276*** (1.973)	8.478*** (2.136)	8.296*** (2.162)	-.133 (.109)	-.055 (.116)	-.157 (.119)
NESEP	16.03*** (4.573)	-3.076 (6.424)	-.695 (6.413)	8.307** (4.044)	-1.171 (5.461)	-.920 (5.482)	-.206 (.229)	-.303 (.244)	-.320 (.247)
AFAM	-6.984** (2.835)	-5.007* (3.040)	-5.382* (3.041)	-6.120** (2.552)	-8.366*** (2.661)	-8.208*** (2.675)	-.212* (.121)	-.193 (.127)	-.124 (.128)
OTHERS	-7.492 (6.119)	-7.940 (6.666)	-7.898 (6.630)	.674 (5.417)	.823 (5.750)	.968 (5.751)	.199 (.313)	.174 (.319)	.177 (.323)
AGE	12.72*** (3.023)	18.45*** (3.216)	20.12*** (3.287)	.702** (.311)	.852*** (.330)	.854*** (.330)	-.020 (.016)	-.027 (.017)	-.023 (.017)
PRIOR	7.843*** (2.216)	9.115*** (2.468)	9.547*** (2.484)	1.169 (2.534)	2.938 (2.655)	2.806 (2.656)	.038 (.125)	.079 (.130)	.054 (.131)
Intercept	12.178	-11.518	-10.408	47.035	33.539	33.510	1.322	.857	.760
N	2,342	1,997	1,997	2,326	1,991	1,991	1,483	1,425	1,425
R^2	.0219	.0282	.0405	.0243	.0789	.0802	N.A.	N.A.	N.A.
-2 LOG L	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1,613.51	1,501.29	1,468.97
Dep. Mean	36.80	35.19	35.19	66.65	66.46	66.46	.7599	.7614	.7614

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

N.A.= not applicable.

2. Accumulated Years of Marriage

The results of estimating the effects of years of marriage on performance for URL males are shown in Table VI.4. The results show that the more years URL males have been married, the more RAP's they receive and the more likely they are to be promoted. URL males who have been married approximately 2 years receive 8.9 percent more RAP's than single officers during grades 1 and 2, while those who have been married approximately 4 years receive 28.8 percent more RAP's than single officers. RAP's received during grade 3 are also higher for officers who have been married longer. URL males who have been married for 3 years receive 4.6 percent more RAP's in grade 3, while officers married for 6 years receive 5.4 percent more. The promotion outcome variable shows similar results. Officers who have been married approximately 3 years are promoted at a 7.7 percent higher rate than officers who have been single. The promotion probability for married officers increases as the years of marriage increases. Officers who have been married for 6 years were 8.6 percent more likely to be promoted, and officers with 10 years of marriage were 10.8 percent more likely to be promoted.

For URL male officers, the results support the view that marriage makes URL male officers more productive. Korenman and Neumark (1991) find that the marriage earnings premium continues to grow with each year of marriage and they cite this finding as evidence that marriage increases productivity. They claim that if the higher wages of married men were due to the selection of men with higher wages in a marriage, then the higher wages of married men would not increase systematically as the years they have been married increase.

For STF/RL male officers, the results in Table VI.5 for RAP's during grades 1 and 2 are not affected by years of marriage. However, RAP's received during grade 3 are negatively correlated with accumulated marriage years. Officers who have been married 3 years received 7.9 percent more grade 3 RAP's, while officers who have been married for 6 years received only 5.5 percent more RAP's than single officers. The promotion outcome for STF male officers almost does not change as the accumulated marriage years change.

Table VI.4. Marriage Premium Based on Accumulated Years of Marriage for URL Males[a].

PCTRAP12		PCTRAP3		PROMO[b]	
SM_ (2 years)	2.686*** (.655)	_SM (3 years)	3.390*** (.819)	SSM (3 years)	.255*** (.039) [.077]
MM_ (4 years)	8.721*** (.780)	_MM (6 years)	3.954*** (.778)	SMM (6 years)	.289*** (.040) [.086]
--	--	--	--	MMM (10 years)	.374*** (.044) [.108]
DW_	-.174 (2.133)	_DW	-.275 (1.454)	DW	.200*** (.070) [.058]
GURL	-17.656*** (2.208)	GURL	-15.281*** (2.934)	GURL	-.836*** (.129)
SUB	4.092*** (.873)	SUB	4.343*** (.866)	SUB	-.020 (.044)
PILOT	-18.545*** (.713)	PILOT	-6.697*** (.703)	PILOT	-.117*** (.035)
NFO	-13.511*** (.835)	NFO	-4.713*** (.742)	NFO	-.141*** (.036)
GPA	3.100*** (.307)	GPA	2.765*** (.293)	GPA	.141*** (.015)
--	--	GRADSCH	3.697*** (.641)	GRADSCH	.245*** (.033)
USNA	-.860 (.794)	USNA	.473 (.776)	USNA	-.025 (.039)
ROTC	-2.251*** (.804)	ROTC	-2.556*** (.792)	ROTC	-.212*** (.039)
NESEP	.481 (1.784)	NESEP	-5.957*** (1.410)	NESEP	.040 (.067)
AFAM	-7.685*** (1.533)	AFAM	-6.196*** (1.444)	AFAM	-.257*** (.066)
OTHERS	-4.735** (1.865)	OTHERS	-3.158* (1.800)	OTHERS	-.201** (.084)
AGE	-.895*** (.177)	AGE	.004 (.167)	AGE	-.074*** (.008)
PRIOR	3.479*** (1.231)	PRIOR	-2.099* (2.140)	PRIOR	-.066 (.055)
Intercept	46.727	Intercept	64.815	Intercept	1.989
N	19,627	N	11,372	N	11,522
R^2	.0710	R^2	.0469	-2 LOG L	12,432.12
Dep. Mean	30.18	Dep. Mean	73.09	Dep. Mean	.7472

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

Table VI.5. Marriage Premium Based on Accumulated Years of Marriage for STF/RL Males[a].

PCTRAP12		PCTRAP3		PROMO[b]	
SM_ (2 years)	-.361 (1.557)	_SM (3 years)	6.099*** (1.708)	SSM (3 years)	.222** (.092) [.071]
MM_ (4 years)	6.451*** (1.609)	_MM (6 years)	4.265*** (1.532)	SMM (6 years)	.220** (.090) [.071]
--	--	--	--	MMM (10 years)	.173* (.089) [.057]
DW_	-3.992 (3.689)	_DW	1.224 (2.525)	DW	.063 (.134) [.021]
RL	9.410*** (1.322)	RL	-.706 (1.078)	RL	.203*** (.063)
GPA	4.947*** (.700)	GPA	2.517*** (.579)	GPA	.103*** (.031)
--	--	GRADSCH	2.555** (1.169)	GRADSCH	.335*** (.066)
USNA	10.868*** (2.234)	USNA	3.368* (1.960)	USNA	.476*** (.119)
ROTC	-4.319** (1.965)	ROTC	-6.321*** (1.722)	ROTC	-.055 (.092)
NESEP	-9.196*** (2.053)	NESEP	-10.103*** (1.660)	NESEP	-.002 (.089)
AFAM	-1.976*** (3.477)	AFAM	-5.351* (2.976)	AFAM	-.107 (.157)
OTHERS	-6.646* (3.897)	OTHERS	-.760 (3.299)	OTHERS	.196 (.181)
AGE	.775** (.301)	AGE	.477** (.234)	AGE	-.021 (.013)
PRIOR	-1.161 (1.992)	PRIOR	-2.043 (1.559)	PRIOR	-.068 (.084)
Intercept	.005	Intercept	55.39	Intercept	.586
N	3,664	N	2,510	N	2,524
R^2	.0613	R^2	.0394	-2 LOG L	2,903.65
Dep. Mean	37.85	Dep. Mean	76.99	Dep. Mean	.7132

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

The results for URL females are shown in Table VI.6.The marriage premium results based on accumulated marriage years are not significant for URL females.

Table VI.6. Marriage Premium Based on Accumulated Years of Marriage for URL Females[a].

PCTRAP12		PCTRAP3		PROMO[b]	
SM_ (2 years)	-2.623 (3.121)	_SM (3 years)	5.231** (2.031)	SSM (3 years)	.055 (.109) [.016]
MM_ (4 years)	4.815 (4.113)	_MM (6 years)	-.842 (2.647)	SMM (6 years)	-.146 (.157) [-.045]
--	--	--	--	MMM (10 years)	.460** (.218) [.113]
DW_	1.761 (2.982)	_DW	1.768 (3.121)	DW	.164 (.158) [.046]
SWO	7.157** (3.171)	SWO	1.251 (2.815)	GURL	.897*** (.199)
PILOT	-8.913** (4.131)	PILOT	-4.886 (4.342)	SUB	.419* (.243)
NFO	-19.908*** (5.266)	NFO	-5.778 (4.730)	NFO	.776** 9.315)
GPA	3.494*** (.919)	GPA	2.285*** (.862)	GPA	.106** (.045)
--	--	GRADSCH	8.985*** (1.571)	GRADSCH	.451*** (.087)
USNA	20.233*** (3.291)	USNA	17.991*** (3.213)	USNA	.207 (.194)
ROTC	9.644*** (2.488)	ROTC	5.791** (2.316)	ROTC	-.191 (.122)
NESEP	-.587 (6.420)	NESEP	-6.139 (5.030)	NESEP	-.295 (.263)
AFAM	-5.409* (3.050)	AFAM	-5.464** (2.667)	AFAM	-.149 (.130)
OTHERS	-7.975 (6.638)	OTHERS	-.924 (6.062)	OTHERS	.105 (.329)
AGE	1.321*** (.383)	AGE	.759** (.330)	AGE	-.036** (.018)
PRIOR	1.211 (3.065)	PRIOR	2.855 (2.604)	PRIOR	.014 (.136)
Intercept	-10.441	Intercept	40.461	Intercept	1.145
N	1,997	N	1,406	N	1,346
R^2	.0398	R^2	.0638	-2 LOG L	1,385.68
Dep. Mean	35.19	Dep. Mean	72.25	Dep. Mean	.7585

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

3. Selection into Marriage

The results of the models constructed to test for selection are shown in Table VI.7. URL male officers who were single during grades 1 and 2 and will be married during grade 3 received 12.7 percent more RAP's during grades 1 and 2 than officers who were single during grades 1 and 2 and remained single during grade 3. STF/RL officers who were single during grades 1 and 2 and will be married during grade 3 received 17.1 percent more RAP's during grades 1 and 2 than officers who were single during grades 1 and 2 and remain single during grade 3. The results for URL female officers are not significant.

The results imply that officers who are single, but who become married later, perform better than those who are single and who do not marry later. These results suggest that at least some portion of the higher RAP's that is received by married officers and a portion of the higher promotion probability of married officers are due to some unobservable characteristics of officers who choose to marry, and the apparent higher performance of married officers is not due entirely to increased productivity by marriage. Rather, the performance difference is in some part due to selection of potentially more successful officers into marriage.

Cornwell and Rupert (1996) use this same methodology in their study. They show that single men who will marry in the future earn more than single men who do not marry in the future. Cornwell and Rupert claim that the entire marriage premium is due to selection bias rather than due to productivity differences because they find that workers who are single and will be married in the future earn at least as much as those who are already married. According to our findings, we cannot attribute all the higher performance of married officers to the selection bias argument. Even if single officers who will marry in the future (SSM) receive more RAP's than single officers who will not marry in the future (SSS), they do not receive as many RAP's as officers who are already married (MMM).

Table VI.7. Analysis of the Effect of Eventual Marriage on Current Performance (PCTRAP12)[a].

VARIABLE	URL Male	STF/RL Male	URL Female
SSM	4.284*** (1.162)	7.109*** (2.519)	-2.564 (2.725)
SMM	4.238*** (1.182)	1.508 (2.479)	-5.464 (4.250)
MMM	9.849*** (1.292)	7.391*** (2.469)	11.203** (5.197)
DW	.090 (2.036)	4.063 (3.679)	-4.201 (4.038)
RL	--	7.627*** (1.577)	--
GURL	-21.519*** (4.186)	--	--
SUB	.463 (1.214)	--	--
SWO	--	--	8.489** (3.657)
PILOT	-21.589*** (.976)	--	-3.859 (5.647)
NFO	-18.240*** (1.044)	--	-17.851*** (6.241)
GPA	3.055*** (.408)	5.672*** (.840)	2.556** (1.134)
USNA	-5.698*** (1.095)	2.119 (2.859)	15.727*** (4.185)
ROTC	-6.311*** (1.120)	-7.229*** (2.508)	4.949 (3.058)
NESEP	-3.802* (2.002)	-11.445*** (2.331)	2.695 (6.933)
AFAM	-8.254*** (2.030)	-10.009** (4.329)	-6.009* (3.491)
OTHERS	-5.723** (2.531)	-6.303 (4.835)	-12.346 (7.983)
AGE	-.517** (.238)	1.216*** (.348)	1.115** (.444)
PRIOR	.562 (1.617)	-4.205* (2.282)	1.569 (3.483)
Intercept	45.255	-10.092	-.457
N	11,254	2,472	1,328
R^2	.0793	.0637	.0389
Dep. Mean	33.65	41.45	35.78

Notes: [a]Each cell includes estimated coefficient, and the standard error in parentheses. Dependent variable for this table is PCTRAP12.

*Indicates significance at .10 level; **at .05; ***at .01 level.

To correct for the potential selection bias in the marriage premium, a fixed-effects model also is estimated. In the model, the change in supervisor evaluations from one time point to another are estimated as a function of the variables that are changing for individuals from one time point to another. The variables such as commissioning background, ethnicity, prior enlisted service and college grade point are not included in the model since they do not change over time. To control for community changes only the officers who do not change their communities are included in the samples for the fixed-effects models. The formulation of the models is similar to the formulation of Korenman and Neumark (1991):

$$(PCTRAP3_i\text{-}PCTRAP12_i) = = \alpha(X_{it} - X_{iT}) + \gamma\,(MST_{it} - MST_{iT}) + \nu_{it}$$

where the dependent variable captures the difference in RAP's accumulated during grades 1 – 3. X_{it} represents the variables during grade 1-2 that changed during grade3, and X_{iT} is the same variables during grade 3 for officer *i.* MST represents the change in marital status during these two periods. Marital status change is coded in three different variables. One variable represents no change in marital status over time (STS_MTM: single to single or married to married), which is omitted from the equation as a base; another (STM) represents the change from single at entry to married at grade 4; and the other variable (DW) represents the change from married to divorced during this period. The results are shown in Table VI.8.

The results show that officers who were single at entry and then married during grades 1 – 3 received higher RAP's compared to officers whose marital status did not change over time. The RAP's received during grade 3 by URL males who were single at entry and got married is 9.42 percent higher than the RAP's received by officers who remained either single or married for ten year period. These RAP changes are 10.88 and 25.82 percent higher for STF/RL male and URL female officers, respectively.

Table VI.8. Fixed-effects model (Dependent variable = 'PCTRAP3-PCTRAP12')[a].

Variable	URL Male	STF/RL Male	URL Female
STM[b]	3.900*** (1.046)	3.852** (1.813)	9.453** (3.704)
DW[c]	-0.367 (2.509)	-1.580 (3.717)	10.017 (6.178)
CHDEP[d]	0.156 (.406)	0.726 (.698)	-2.724* (1.479)
GRADSCH	-7.432*** (1.030)	-5.185*** (1.606)	-1.335 (2.333)
N	9,343	2,521	1,140
R^2	.0078	.0086	.0062
Dep. Mean	41.40	35.39	36.61

Notes: [a]Each cell includes estimated coefficient, and the standard error in parentheses.

[b]Those whose marital status changes from single to married between entry and O3.

[c]Those whose marital status changes from married to single between entry and O3

[d]Change in number of dependents between entry and O3

*Indicates significance at .10 level; **at .05; ***at .01 level.

4. Number of Dependents

Table VI.9 shows the results of estimating the effect of dependents on performance for URL males. URL males who have more dependents receive higher RAP's during the entire ten-year period. While married officers with a spouse only receive 22.9 percent more PCTRAP12 than the single officers, this difference increases for each additional dependent reaching 41.2 percent higher for married officers who have three or more dependents. PCTRAP3 is 4.8 percent higher for married officers who have only a spouse as a dependent, but the difference reaches 15.2 percent higher for married officers who have a spouse and three or more dependents. The results for promotion outcome are not consistent depending on the number of dependents.

Tables VI.10 and VI.11 show the results for STF/RL males and URL females, respectively. The results for STF/RL males also show that officers with more dependents receive more RAP's. Married officers with only a spouse receive 21.2 percent more PCTRAP12 than single officers, and married officers with three or more children receive 27.5 percent more PCTRAP12 than the single officers. Married officers with one child

receive 8.6 percent more PCTRAP3 and married officers with three or more children receive 12.0 percent more PCTRAP3. The results for PROMO are not significant. For URL females the results reveal no differences between single and married.

If we compare URL males with STF/RL males, STF/RL male officers' performance difference based on the number of dependents is smaller. One explanation is that since STF/RL officers do not deploy as often as URL officers (URL officers also travel overseas more), STF/RL officers may devote more time to their dependents and devote less time to work. Anderson and Krieg (2000) claim that more dependents may cause married workers to spend more time doing household work and to specialize less in market work. Our results do not justify this claim completely since as the number of dependents increase performance also increases. The only justification may be that more dependents require allocating more time for household work. Rather, our results justify the Hill's (1979) claim that more dependents mean more responsibility for a married man, which causes them to work harder and perform better.

Table VI.9. The Effect of Number of Dependents on Performance for URL Males[a].

PCTRAP12		PCTRAP3		PROMO[b]	
SPSONLY0	6.933*** (.796)	SPSONLY1	3.071*** (.544)	SPSONLY2	.247*** (.040) [.074]
SPS_1CH0	7.159*** (1.631)	SPS_1CH1	4.828*** (.887)	SPS_1CH2	.338*** (.042) [.098]
SPS_2CH0	8.454*** (2.028)	SPS_2CH1	6.202*** (1.201)	SPS_2CH2	.320*** (.040) [.094]
SPS_3CH0	12.448*** (3.406)	SPS_3CH1	9.600*** (2.032)	SPS_3CH2	.207*** (.050) [.061]
DIVCH0	--	DIVCH1	4.307 (2.655)	DIVCH2	.216** (.095) [.063]
GURL	-17.672*** (2.242)	GURL	-16.368*** (2.074)	GURL	-.806*** (.125)
SUB	4.088*** (.878)	SUB	5.596*** (.761)	SUB	-.018 (.044)
PILOT	-18.348*** (.715)	PILOT	-4.651*** (.625)	PILOT	-.106*** (.034)
NFO	-13.389*** (.839)	NFO	1.801*** (.726)	NFO	-.137*** (.036)
GPA	3.128*** (.309)	GPA	2.670*** (.269)	GPA	.143*** (.015)
GRADSCH	--	GRADSCH	12.598*** (.699)	GRADSCH	.246*** (.033)
USNA	-.905 (.798)	USNA	7.493*** (.694)	USNA	-.026 (.039)
ROTC	-2.431*** (.810)	ROTC	2.169*** (.702)	ROTC	-.214*** (.039)
NESEP	.650 (1.816)	NESEP	.332 (1.558)	NESEP	.049 (.066)
AFAM	-7.705*** (1.556)	AFAM	-6.652*** (1.353)	AFAM	-.256*** (.066)
OTHERS	-4.578** (1.875)	OTHERS	-2.084 (1.631)	OTHERS	-.202** (.084)
AGE	-.941*** (.184)	AGE	-.574*** (.157)	AGE	-.070*** (.008)
PRIOR	3.209** (1.255)	PRIOR	3.727*** (1.084)	PRIOR	-.057 (.054)
Intercept	48.726	Intercept	62.352	Intercept	1.893
N	19,446	N	19,583	N	11,640
R^2	.0699	R^2	.0605	-2 LOG L	12,575.02
Dep. Mean	30.18	Dep. Mean	63.16	Dep. Mean	.7462

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

Table VI.10. The Effect of Number of Dependents on Performance for STF/RL Males[a].

PCTRAP12		PCTRAP3		PROMO[b]	
SPSONLY0	8.034*** (1.663)	SPSONLY1	1.966 (1.266)	SPSONLY2	.248*** (.091) [.079]
SPS_1CH0	.814 (2.594)	SPS_1CH1	5.963*** (1.795)	SPS_1CH2	.161* (.090) [.052]
SPS_2CH0	7.583*** (2.864)	SPS_2CH1	3.085 (2.050)	SPS_2CH2	.181** (.085) [.059]
SPS_3CH0	10.401** (4.760)	SPS_3CH1	8.272*** (3.097)	SPS_3CH2	.139 (.100) [.045]
--	--	DIVCH1	3.850 (4.239)	DIVCH2	.085 (.176) [.028]
RL	9.144*** (1.334)	RL	1.754 (1.140)	RL	.198*** (.062)
GPA	4.869*** (.706)	GPA	1.996*** (.607)	GPA	.107*** (.031)
--	--	GRADSCH	10.559*** (1.327)	GRADSCH	.337*** (.065)
USNA	10.444*** (2.242)	USNA	7.294*** (1.927)	USNA	.472*** (.118)
ROTC	-4.510** (1.974)	ROTC	-6.775*** (1.694)	ROTC	-.057 (.092)
NESEP	-9.271*** (2.053)	NESEP	-9.383*** (1.831)	NESEP	.012 (.088)
AFAM	-13.776*** (3.564)	AFAM	-6.905** (2.995)	AFAM	-.103 (.156)
OTHERS	-6.029 (3.922)	OTHERS	-5.155 (3.371)	OTHERS	.162 (.179)
AGE	.669** (.315)	AGE	.293 (.266)	AGE	-.021 (.013)
PRIOR	-1.082 (2.027)	PRIOR	2.078 (1.744)	PRIOR	-.062 (.083)
Intercept	2.618	Intercept	51.709	Intercept	.570
N	3,602	N	3,629	N	2,561
R^2	.0621	R^2	.0517	-2 LOG L	2,947.31
Dep. Mean	37.79	Dep. Mean	68.88	Dep. Mean	.7130

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

Table VI.11. The Effect of Number of Dependents on Performance for URL Females[a].

PCTRAP12		PCTRAP3		PROMO[b]	
SPSONLY0	6.659 (4.224)	SPSONLY1	-4.390* (2.546)	SPSONLY2	.044 (.117) [.013]
SPS_1CH0	8.030 (8.806)	SPS_1CH1	9.318** (4.435)	SPS_1CH2	.047 (.144) [.014]
SPS_2CH0	2.067 (15.046)	SPS_2CH1	-3.166 (8.907)	SPS_2CH2	-.011 (.159) [-.003]
--	--	SPS_3CH1	33.440 (31.739)	SPS_3CH2	-.219 (.326) [-.070]
--	--	DIVCH1	3.573 (4.730)	DIVCH2	-.176 (.197) [-.055]
SWO	7.914** (3.205)	SWO	4.206 (2.732)	SWO	.884*** (.199)
PILOT	-8.416** (4.153)	PILOT	-2.585 (3.600)	PILOT	.310 (.233)
NFO	-19.025*** (5.355)	NFO	.105 (4.556)	NFO	.791** (.311)
GPA	3.206*** (.951)	GPA	1.689** (.801)	GPA	.114*** (.044)
--	--	GRADSCH	14.873*** (1.625)	GRADSCH	.462*** (.084)
USNA	20.260*** (3.391)	USNA	19.999*** (2.857)	USNA	.187 (.189)
ROTC	8.421*** (2.572)	ROTC	8.230*** (2.162)	ROTC	-.161 (.119)
NESEP	4.078 (7.164)	NESEP	-1.664 (5.483)	NESEP	-.323 (.248)
AFAM	-4.385 (3.171)	AFAM	-9.079*** (2.689)	AFAM	-.117 (.128)
OTHERS	-11.597* (6.961)	OTHERS	1.285 (5.745)	OTHERS	.184 (.325)
AGE	1.099*** (.424)	AGE	.773** (.337)	AGE	-.022 (.017)
PRIOR	2.597 (3.274)	PRIOR	2.998 (2.654)	PRIOR	.063 (.132)
Intercept	-4.570	Intercept	35.591	Intercept	.745
N	1,847	N	1,991	N	1,425
R^2	.0398	R^2	.0846	-2 LOG L	1,467.53
Dep. Mean	35.03	Dep. Mean	66.46	Dep. Mean	.7614

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets.

[b]PROMO model includes dummies for fiscal years 87 – 95 as explanatory variables, but to conserve space these are not presented.

*Indicates significance at .10 level; **at .05; ***at .01 level.

5. Human Capital Investment

In an organization, investment in human capital can be measured with three different variables: firm-specific training, tenure and formal education. Since the first two variables are the same in our officer groups, we analyze the relationship between graduate education and marital status. In the Navy, graduate education is a mix of firm-specific and general training.

The goal is to determine whether marriage may provide an incentive for married employees to invest more in formal education. The results of the graduate education model are displayed in Table VI.12. It shows that for URL males and STF/RL males, married officers are more likely to invest in graduate school education (by approximately 4 – 11 percentage points) than single males. For URL females no differences was observed between single and married officers.

Table VI.12. The Effect of Marriage on Graduate School Education[a].

Variable	URL Male	STF/RL Male	URL Female
SSM	.164*** (.042) [.050]	.128 (.095) [.044]	.035 (.098) [.013]
SMM	.246*** (.043) [.076]	.248*** (.093) [.086]	-.001 (.150) [-.0002]
MMM	.233*** (.046) [.072]	.330*** (.093) [.114]	.064 (.184) [.024]
DW	-.029 (.075) -[.009]	.080 (.140) [.027]	-.185 (.146) [-.066]
GURL	-.448*** (.142)	--	--
SUB	-.555*** (.042)	--	--
SWO	--	--	.051 (.130)
PILOT	-.750*** (.038)	--	-.600*** (.225
NFO	-.333*** (.036)	--	-.357 (.2351)

Table VI.12. The Effect of Marriage Years on Graduate School Education[a] (cont).

Variable	URL Male	STF/RL Male	URL Female
RL	--	.011 (.059)	--
GPA	.244*** (.015)	.236*** (.032)	.202*** (.0414)
USNA	.286*** (.040)	.447*** (.103)	.550*** (.149)
ROTC	.180*** (.041)	.325*** (.090)	.221** (.110)
NESEP	.207*** (.066)	1.085*** (.082)	-.186 (.252)
AFAM	-.183** (.074)	-.065 (.170)	.096 (.124)
OTHERS	.062 (.087)	-.265 (.204)	.103 (.287)
AGE	.007 (.008)	.030** (.013)	.045*** (.016)
PRIOR	-.028 (.057)	-.454*** (.087)	-.082 (.124)
Intercept	-1.606	-2.341	-2.142
N	11,590	2,539	1,352
-2 LOG L	11,847.44	2,792.53	1,717.39
Dep. Mean	.2370	.2950	.3572

Notes: [a]Each cell includes estimated coefficient, and the standard error in parentheses. Dependent variable for this table is GRADSCH.

*Indicates significance at .10 level; **at .05; ***at .01 level.

B. NONRANDOM SAMPLE SELECTION DUE TO RETENTION

Simple t-tests showed that retention differs between single and married for both URL and STF/RL males (see Table V.24). This difference might cause biased estimates if leavers systematically differ from stayers and the unobserved characteristics that explain this difference are correlated with performance. This section accounts for nonrandom sample selection in retention for the PCTRAP3 and PROMO models for URL and STF/RL males. In particular, a Heckman-style two-step model is used to estimate the PCTRAP3 model. Since both retention and promotion are binary, a bivariate probit is used to estimate the PROMO model (Greene, 2000).

For both proxies, in the first stage of the two-step models the determinants of retention are estimated. The retention model includes not only marital status but also commissioning background, ethnicity, age and GPA. It also includes instrumental variables to identify the retention model. The instruments include officer's community (GURL, SUB, PILOT, SUB, NFO), which should reflect differences in civilian marketability, and staled preferences for a Navy-funded graduate education program. The preferences variable (PREFER) signals long-term career intentions in the Navy because graduate school attendees incur an additional service obligation. Finally, prior enlisted service (PRIOR) is included as an instrument. These instrumental variables are omitted in the PROMO model (the second stage), since the system is identified when at least one variable in the selection equation is omitted from the structural model (Bowman and Mehay, 2001). Results of the retention models are presented in Table VI.13.

Table VI.13. Probit Retention (to O4) Models[a].

Variable	URL Male	STF/RL Male
MARRIED1	.108*** (.018)	.220*** (.043)
USNA	.375*** (.025)	.012 (.074)
ROTC	.278*** (.025)	-.021 (.064)
NESEP	.978*** (.072)	.319*** (.077)
GURL	-.805*** (.067)	--
SUB	-.051 (.027)	--
PILOT	.203*** (.023)	--
NFO	.567*** (.028)	--
RL	--	.332*** (.047)
AFAM	.073 (.048)	-.046 (.119)
OTHERS	-.032 (.059)	-.175 (.137)
AGE	.034*** (.006)	.040*** (.011)
PRIOR	.385*** (.040)	.561*** (.073)
GPA	-.016 (.010)	-.006 (.024)
PREFER	.372*** (.023)	.324*** (.042)
Intercept	-1.143*** (.142)	-.139*** (.275)
N	22,101	4,072
-2 Log L	28,573.62	4,908.98

Notes: [a]Each cell includes estimated coefficient, and the standard error in parentheses. Dependent variable for this table is STAY.

*Indicates significance at .10 level; **at .05; ***at .01 level.

The results of the selection corrected models (PCTRAP3 and PROMO) are presented in Table VI.14. The positive coefficient of lambda (λ) in the PCTRAP3 model indicates that unobservables associated with retention decisions are correlated with higher RAP scores during the six years in grade 3 (PCTRAP3). The coefficient of lambda is positive for both URL and STF/RL males, but significant only for URL males. In other words, some unobservable characteristics of URL males that explain retention are significantly and positively correlated with PCTRAP3. RAP scores of URL and STF/RL males are 5.5 and 4.2 percent, respectively higher than for single officers in the OLS estimates in columns 1 and 3. However, after controlling for self-selection married URL males, receive only a 3.2 percent higher premium in RAP scores in column 2. Among STF/RL males no significant self-selection is observed between the stay-leave decisions and RAP scores as the lambda term is insignificant in column 4. However, the effect of marital status is no longer significant.

In the promotion model, the negative error covariance (Rho) indicates that, holding all variables constant, those who left before the promotion point had a higher predicted promotion probability. The error covariance term is significant for STF/RL males, but not for URL males. Among URL males both the simple probit model and the selection corrected model find approximately 9 percentage points higher promotion probabilities for married officers. Married STF/RL males have approximately 5.3 percentage points higher promotion probability than single males in the simple probit, but after controlling for retention the promotion premium falls to 4.4 percentage points.

Table VI.14. Effects of Marital Status in Selection-Corrected Models[a].

Variable	PCTRAP3				PROMO			
	URL male		STF/RL male		URL male		STF/RL male	
	OLS	Two-stage model	OLS	Two-stage model	Probit	Two-stage model	Probit	Two-stage model
MARRIED1	3.527*** (.498)	2.357*** (.579)	2.918*** (1.114)	.856 (1.229)	--	--	--	--
MARRIED2	--	--	--	--	.263*** (.032) [.087]	.260*** (.032) [.082]	.155** (.068) [.053]	.121* (.069) [.044]
Lambda (λ)	--	12.687*** (1.697)	--	1.095 (4.453)	--	--	--	--
Rho (ρ)	--	--	--	--	--	-.074 (.077)	--	-.506** (.042)
N	19,583	11,324	3,629	2,498	11,640	22,101	2.561	4,072
Dep. Mean	63.16	73.21	68.88	77.11	--	--	--	--

Notes: [a]Each cell includes estimated coefficient, standard error in parentheses, and partial effect in brackets. Both models include GPA, GRADSCH, PRIOR, USNA, ROTC, NESEP, AFAM, OTHERS, and AGE (dummies for fiscal years 87 - 95 in PROMO) as explanatory variables but to conserve space these are not presented in table.

*Indicates significance at .10 level; **at .05; ***at .01 level.

VII. SUMMARY AND CONCLUSIONS

A. SUMMARY

Simple statistical tests show that married male officers receive higher supervisor evaluations and are promoted at higher rates than single male officers. The results also show that there is a positive relationship between supervisor evaluation scores and promotion outcomes. Also, officers who receive higher RAP's are promoted at higher rates than those who receive fewer RAP's.

The analysis of the effects of marital status using OLS regression models shows that married officers generally have better performance than single officers. Male unrestricted line officers who were married when they entered the Navy received 24 percent more RAP's on grades 1 and 2 fitness reports than officers who were single at entry. During grade 3, officers who were married at the beginning of grade 3 received 6 percent more RAP's than officers who entered grade 3 as single. At the O4 promotion point, officers who were married were promoted at a 9 percent higher rate than officers who were single.

Male staff officers who were married when they entered the Navy received 16 percent more RAP's during grades 1 and 2 than officers who were single at entry. During grade 3, officers who were married at the beginning of grade 3 received 4 percent more RAP's than officers who started grade 3 as single. At the grade 4 promotion review, officers who were married were promoted at a 6 percent higher rate than single officers. For URL females, officers who were married at entry received 15 percent more RAP's during grades 1 and 2. The effect of marriage on PCTRAP3 and PROMO are not significant for URL female officers.

The analysis of the effects of the years of marriage shows that the more years URL male officers have been married, the more RAP's they receive and the higher their promotion rates. Increasing performance with increasing years married provides evidence that marriage increases the productivity of URL males. For STF/RL males, the results are not the same. STF/RL male officers receive more RAP's when they have fewer years of marriage. Based on these results, it is difficult to claim that marriage does not increase

the productivity of STF/RL male officers. Even if the performance measures do not increase with the years married, married officers still receive higher scores than single officers. One explanation may be that since staff officers spend more time at home than line officers, many of whom are deployed overseas, staff officers devote more time to household production. The results of the models analyzing the relationship between the number of dependents and performance support this explanation.

For both URL and STF/RL males, performance indicators increase with the number of dependents. Having more dependents increases the performance of URL males more than that of STF/RL males. The positive effect of dependents on productivity due to increased responsibility may be lower for STF/RL officers due to time demands of household duties. While married URL officers with a spouse (but no children) receive 22.9 percent more PCTRAP12's than single URL officers, this difference increases for each additional dependent, reaching a difference of 41.2 percent for married officers who have three or more dependents. For STF/RL males these differences are 21.25 percent and 27.52 percent, respectively.

The analysis of selection into marriage shows that, for both URL and STF/RL males, single officers who will marry in the future receive more RAP's than single officers who will remain single in the future. URL male officers who were single during grades 1 and 2 and will be married during grade 3 received 12.7 percent more RAP's during grades 1 and 2 than officers who were single during grades 1 and 2 and remained single during grade 3. STF/RL males who were single during grades 1 and 2 and will be married during grade 3 received 17.1 percent more RAP's during grades 1 and 2 than officers who were single during grades 1 and 2 and remained single during grade 3. These results show that at least some portion of the higher performance of married officers that are attributed to marriage is not due to increased productivity, but is due to potentially more successful officers choosing to marry.

Fixed effects models are estimated to calculate the effects of marriage on productivity corrected of selection bias. The results show that officers who were single at entry and then married during grade 4 received higher RAP's when they were married than when they were single. The RAP's received during grade 3 by URL male officers

who were single at entry and got married before O4 is 9.42 percent higher than the change in RAP's between grade 3 and grade 1-2 for officers who remained either single or married for the entire ten year period. This RAP change for STF/RL male officers is 10.88 percent. These results are evidence that even after controlling unobservable individual characteristics the positive effect of marriage on the performance of officers can still be observed.

Differences in human capital investments may be one reason that productivity differs between married and single officers. To test for such differences we analyzed the determinants of graduate degrees. The results of OLS models of the determinants of graduate degrees show that married officers make higher investments in human capital. Since firm-specific training and tenure are the same for all Naval officers, graduate education is the only human capital investment that officers can make. The results show that URL and STF/RL males who are married have attained more graduate education than single officers.

Married officers stay in the Navy in higher proportions (See Table V.24). In the estimation of the effects of marriage on productivity, to correct for probable biases that would arise because of this higher retention of married male officers, a Heckman style two-step model was estimated. The results of this model show that the PCTRAP3 premium for married URL males falls by about half in the retention-corrected models from 6 percent to 3 percent. The PROMO variable results remained constant after adjusting for retention differences and found no significant selection bias.

Overall results suggest that married male officers receive 4-24 percent higher evaluations from their supervisors and also promote at a 4-8 percent higher rate than single officers. Anderson and Krieg (2000) obtained the same positive relationship between marriage and supervisors' evaluation scores and promotion outcomes in U.S. Marine Corps data. They found that married Marines without dependents are 4.7 percent higher than unmarried Marines in promotion probability to E-4 while married Marines without dependents receive .15 points higher scores (scale is from 0 to 5) than single Marines in E-2's performance evaluation. Korenman and Neumark (1991) also obtained similar results using a company-level data set. They found that male workers who are

married in the company receive higher performance ratings from their supervisors and are promote 10.5 percent higher than single workers.

B. CONCLUSIONS

Married males achieve higher performance than single officers. The results of all models show that the higher performance of married males is mostly due to increased productivity associated with marriage. The higher performance for married officers falls somewhat in the two-step models that adjust for selection and thus suggests a small selection bias. At least some portion of the apparent success of married officers is due to the choice of higher 'qualified' officers to marry and unobservable factors correlated with both marriage and performance. However, after controlling for these unobservable individual-specific higher 'qualifications' in fixed-effects models, the performance premium for married males was still positive.

C. POLICY ISSUES

The results show that marriage both increases retention and also the productivity of male officers in the Navy. In the Navy, Quality of Life (QOL) policies supporting family life help to increase retention and the productivity of male officers who are married. The main QOL programs that supporting families in the military are the following: Child Care Program, Exceptional Family Member Program, Family Advocacy Program, Family Member Employment Program, Marriage Enrichment Program and Youth and Teen Program. Thus, these programs that support families thus have an indirect effect on retention and officer performance.

Another important finding of the study is that the positive effect of marriage is higher for male unrestricted line officers. This is contrary to the expectation that because URL officers have more overseas duties, deploy more frequently, and are subject to extensive family separation they would be less productive. Because of the argument that marriage increases the responsibility of married officers, this higher responsibility may cause married males to work harder. Staff officers do not deploy as much and may have to allocate more time to household production. Hence, they may allocate more time to their families than URL officers. However, it must also be considered that URL male officers marry in lower proportion than STF/RL male officers, especially in the early

career periods. The expectation of long family separation may cause them to delay marriage decisions.

D. LIMITATIONS OF THE STUDY

The analysis of the marriage premium here is primarily based on a single binary variable for marriage. The 'single' group consists of both never married officers and officers who are divorced or widowed. It would be useful to divide marital status into single, married, divorced and widowed.

The 'accumulated years of marriage' variable is calculated by taking the average at three time points. The exact date of marriage is not available in the Navy data. Calculating the accumulated marriage years more precisely would be better when analyzing the effects of accumulated years of marriage.

The data set does not include information about the spouses of the officers. This limitation prevents an analysis of the specialization hypothesis. In the literature review the specialization argument is tested by estimating the effect of the spouse's labor force status on the husband's earnings. When testing the specialization argument, as Hersh and Stratton (2000) did in their study, calculating the actual hours spent in household production by a married officer is a good approach. As a further step, the hours spent in household production by a single officer also should be calculated.

The employer favoritism hypothesis could not be tested directly in this study. Researchers test this argument by comparing the productivity of self-employed married men and self-employed single men. The data set used in this study does not allow for making such a distinction. To be able to test if employer favoritism exists in supervisor evaluation scores, it would be necessary to identify the supervisors who evaluated each officer and test whether there is bias in their evaluation based on the correlation between the marital status of the rater and the rated person.

Finally, the effects of marriage on an officer's life are calculated for only early and mid career period. Spouses play a larger role in the officer's late career life. There is no data about the officer's late career life in this study. When analyzing the effects of dependents on productivity, it would be better to consider the ages of the children as well

as the number of children. However, data on the age of dependents is not included in the data.

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